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PUBLIC WORKS

CITY COUNTY STATE

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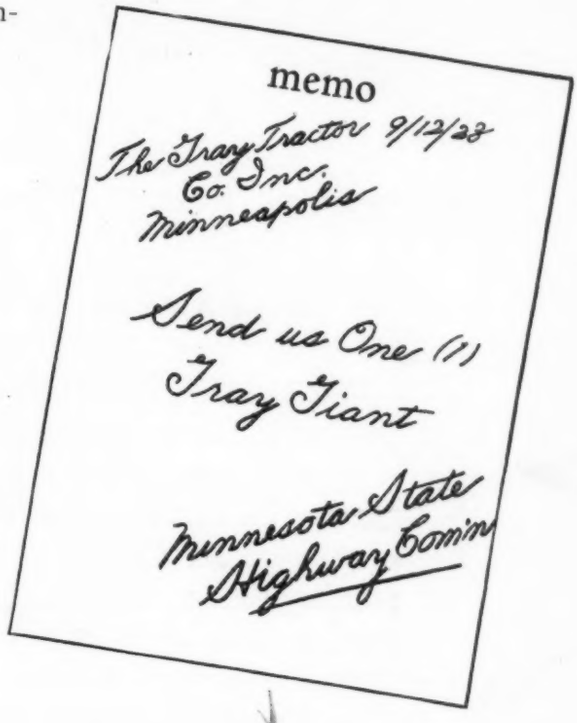

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OCTOBER, 1923

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VOL. 54 NO. 10

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OCTOBER, 1923

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Vol. 54 October, 1923 No. 10

Garbage Collection in Saint Paul

By James W. Routh, M. Am. Soc. C. E.*

Lowered cost and improved service secured by substitution of trailers, horse-drawn for collections and tractor-drawn in trains of three to pig farms, for team and wagon collection formerly employed, and still retained temporarily over a large part of the city.

Definite steps have been taken recently towards the solution of the problem of garbage collection in the city of Saint Paul. In an article which appeared in Public Works, March 11, 1922, the then existing procedure in garbage collection was discussed by the writer at some length. Until recently funds have been unavailable for effecting improvements indicated as necessary at that time, but during the last summer it was found possible to appropriate sufficient money for a partial installation of tractors and trailers, details of which are given herein.

GENERAL DATA

At the risk of duplication, certain physical data are reproduced:

The population of the city of Saint Paul is approximately 245,000; the topography is hilly, and the total land area of the city is approximately 52 square miles. There are about 840 miles of streets, of which approximately 25 per cent are paved.

Garbage is disposed of in Saint Paul by feeding it to hogs and by the individual householders burning and burying it. The city does not own a disposal plant, but garbage is fed to pigs by farmers in the immediate vicinity. Some of these men come into the city, operating under license, and collect garbage in selected routes, hauling it to their farms outside of the city limits. There also are three larger piggeries, privately owned and operated, which buy from the city garbage which is collected and delivered to them by collectors employed and paid by the city.

FARMER COLLECTORS

At the date of writing there are thirty farmers operating under license and collecting garbage within the city. These men pay an annual fee of ten dollars each. Nine of them have been assigned routes in the residential sections of the city and are presumed to make two collections each week from them. The remaining 21 farmer collectors take garbage only from hotels, restaurants, clubs, etc. No accurate records are available of the quantity of garbage collected by the latter.

The sections of the city not served by farmer col-

*Consulting Engineer, Saint Paul Bureau of Municipal Research.

FIG. 1—TRAIN OF TRACTOR AND THREE TRAILERS HAULING GARBAGE to PIGGERIES.

lectors are covered by collectors employed directly by the city, and working under the supervision of the superintendent of sanitation in the department of public works. During the first seven months of 1923 there were an average of 37 city collectors, who collected and delivered approximately 6,500 tons of garbage to the three piggeries under contract for disposal.

CITY COLLECTORS

During the last two years the public works department has endeavored consistently to replace farmer collectors with collectors who are under the direction of the superintendent of sanitation. This was found necessary because of the difficulty of controlling the individual farmer collectors, who are inclined to display a considerable amount of independence in their choice of equipment and work methods. Some of them have proved satisfactory and regular in their collections, and the better class of collectors, of course, have been retained until the last. The procedure followed is to replace with city collectors the farmers on whose routes complaints multiply.

Until July 1st the city's collectors were paid the rate of $160 per month each. For this sum they provide a driver, who collects, a team and the running gear of a wagon. The wagon boxes are furnished by the city and have a capacity of three cubic yards. They can be emptied only by shoveling and are not water tight; consequently they are unsanitary, even though well cared for and frequently washed.

On July 1st the team rate increased to $168 per month. Under the system of collection by teams the collection cost has been high, approximately $7.00 per ton, the average haul being 4.5 miles.

SALE OF GARBAGE

For the current year, beginning September 1, 1923, the prices per ton paid to the city for garbage delivered to the three piggeries under contract for its disposal are as follows:

District No. 1—$ .90 per ton
District No. 2— 1.07 per ton
District No. 3— .75 per ton

The revenue realized from the sale of garbage is approximately $12,000 per year and is applied to reducing the cost of collection.

TRAILER INSTALLATION

The first installation of trailers and tractors was made following the purchase by the city of twelve side-dump trailers specially designed for use in garbage collection. Figure 1 is a photograph of several of these trailers, which cost $1,595 each. They are drawn by teams for the house to house collections, and are hooked together in trains of three which are drawn from central points to the

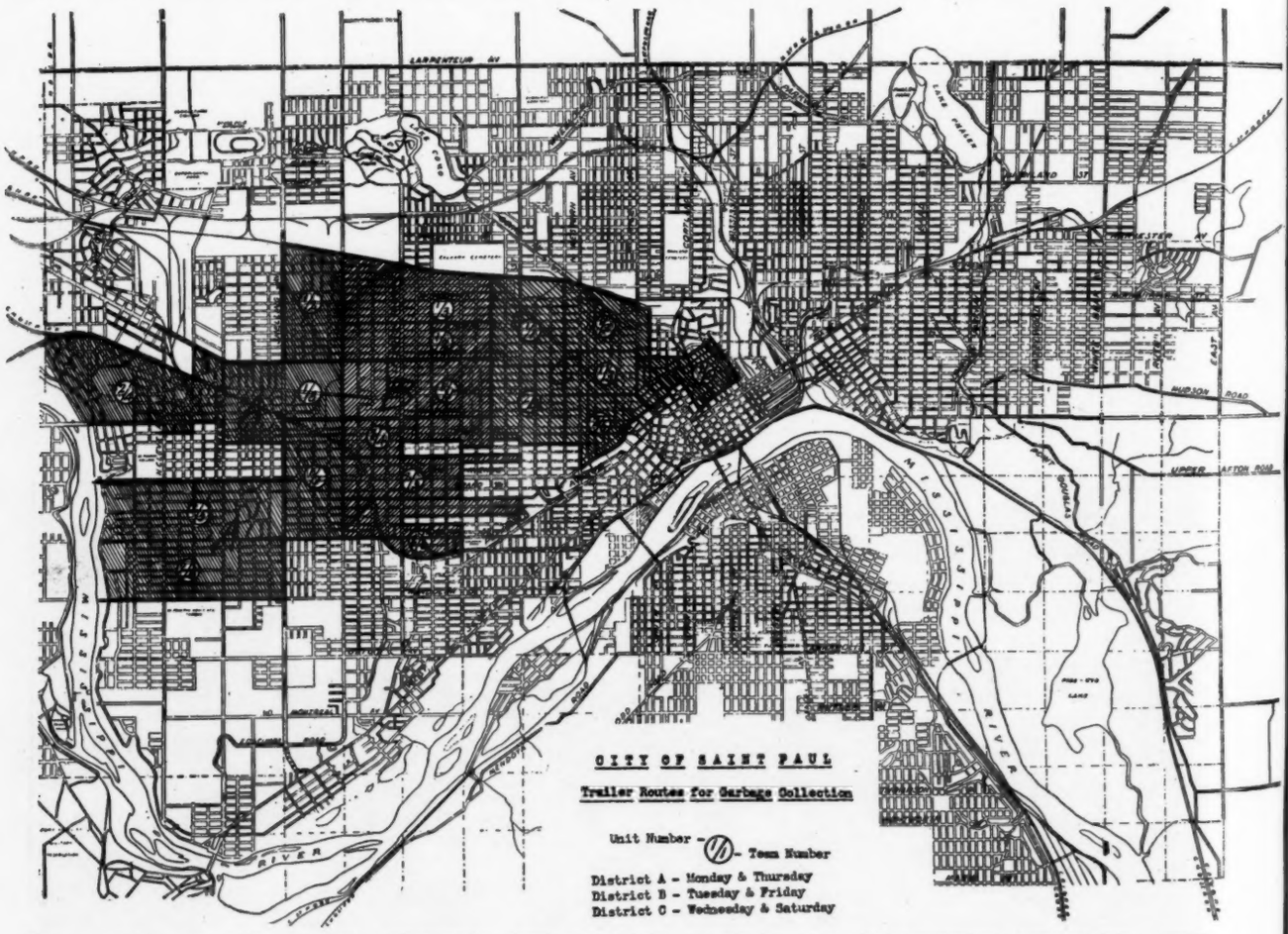

CITY OF SAINT PAUL
Trailer Routes for Garbage Collection
Unit Number - 11 - Team Number
District A - Monday & Thursday
District B - Tuesday & Friday
District C - Wednesday & Saturday
MISSISSIPPI RIVER
HUDSON ROAD
RIVER

FIG. 2—MAP OF SAINT PAUL, SHOWING THE TRAILER ROUTES AND COLLECTION DISTRICTS. THE DIFFERENT DISTRICTS ARE INDICATED BY THE DIFFERENT SLOPES OF THE CROSS-HATCHING.

piggeries by tractors. Two 5-ton tractors were purchased by the city for this purpose, at a cost of $4,115 each. The trailers are equipped with canvas covers which were purchased separately. The trailers are of special drop-frame construction manufactured by the Highway Trailer Company. They are drawn by 5½-ton G. M. C. tractors.

Figure 2 is a map of the city on which is shown shaded the area served by the tractor-trailer units. The unshaded portions of the city are covered by team collectors, part of whom are employed directly by the city and part of whom, as noted, are farmer collectors operating under license.

The twelve trailers are used in two units of six trailers each. Three teams are employed in each collection unit and are hired at the rate of $8.40 per team per day. The tractors are owned by the city, as stated, and the rate of pay for drivers is $5.08 per day. In addition, there is required a trainman or brakeman for each tractor, who is employed at the rate of $4.40 per day.

COLLECTION PROCEDURE

The area served by the tractor-trailer collectors is divided, as indicated on the map, into three districts. Collections are made in these districts twice a week, the routes for the work being so laid out that each trailer obtains its load in a prescribed time and is then drawn to a central meeting point, where the other two trailers of the unit are joined to it in a train and drawn by the tractor to the disposal point. The tractor, in coming to the meeting point, brings with it three empty trailers which are taken by the teams discharging their loaded trailers and used to collect their next loads.

The installation of the trailers was made under the direction of a representative of the trailer manufacturer, who supervised the laying out of the routes and the instruction of the drivers, and who will return periodically to check up the efficiency of the service and to make such adjustments as seem necessary in order that the work may be carried along properly.

It was noted in the original investigation (made by the writer) of garbage collection in Saint Paul that the collectors worked on an average about 5½ hours a day and actually collected during only 2 or 2½ hours; the remainder of the time was required to haul the loaded wagons to the piggeries. With the trailers a larger load is collected than was possible with the old wooden wagon boxes, and it is possible to collect three loads instead of one each day, the teams and collectors working a full eight hours.

In the district served by the tractor-trailer units there formerly were eighteen collectors. These have been replaced by six teams, two tractors and twelve trailers.

COMPARATIVE COSTS

The tractor-trailer system has been in operation too short a time to permit of accurate cost determinations, but a record system has been installed which enables some approximations to be made. Indications from figures thus far available are that the writer's original estimate—a probable unit cost in the neighborhood of $4.25 per ton—will not be far from the actual cost.

The approximate cost per day of the two units now in operation is as follows:

2 5-ton tractors (operation and depreciation)	@	$12.00—	$24.00
2 Tractor drivers	@	5.08—	10.16
2 Trainmen	@	4.40—	8.80
6 Teams	@	8.40—	50.40
12 Trailers—depreciation, etc.	@	1.25—	15.00
Total cost per day			$108.36

Each team collects three loads per day, averaging 1.5 tons per load, or a total daily tonnage by the six teams of 27 tons. This gives a cost per ton, exclusive of supervision, of $4.10, as compared with a cost of $7.00 per ton under the former method of collection by teams and wagons. On occasion this figure is improved on, since on days when the garbage is especially heavy as high as 35 tons have been collected at a cost of $3.10 per ton.

CONCLUSION

In addition to the reduced cost, the new collection system accomplishes two highly desirable results:

(a) The territory served actually obtains two collections each week. Formerly the frequency averaged two collections in ten days.

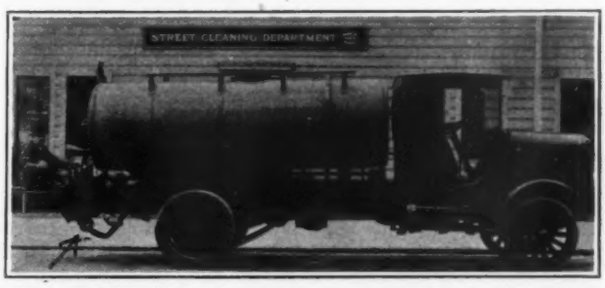
(b) The garbage is collected and hauled through the city streets in water-tight, steel containers, thus alleviating a near nuisance which was unavoidable with the use of the old wooden wagon boxes.

Provision has been made in the city budget for 1924, now before the city council, for funds to purchase additional tractors and trailers to cover the entire city. When this is done licenses to farmer collectors will no longer be granted, and it is hoped that within the next year or two private collection of garbage will be practically discontinued.

There are certain minor problems yet to be considered in making the complete installation, however. One is the question of collections in certain sections of the city where houses are few and widely separated. It has been suggested that such sections can be served by two or more light trucks, which also could be used to make pick-up collections in response to complaints.

Lighting Street for Night Flushing

Street flushing machines in San Francisco intended for flushing at night are provided with a flash or spotlight for illuminating the pavement where the stream is being directed so as to aid the operator in cleaning the pavement more effectively. The light is located just behind the nozzle.



SAN FRANCISCO STREET FLUSHER FOR NIGHT WORK
Arrow points to spotlight used to illuminate pavement and aid operator.

Winter Shipment of Brick

Appearing before the American Construction Council at its meeting on September 21st, the Secretary of the National Paving Brick Manufacturers Association, E. E. Duff, urged that the council encourage shipment of vitrified paving brick during the winter, spring and early summer months and thus avoid the congestion in shipment that annually occurs in September, October and November. Mr. Duff pointed out the physical difficulties encountered by the manufacturer and the monetary loss to the consumer when a big proportion of the shipments had to be made during the fall months when railroad cars are at a premium and transportation systems taxed to capacity. This early shipment could be greatly facilitated if municipalities and highway departments would provide the contractor with a substantial estimate on the material as it is delivered.

Civil Service Examinations

The following examinations are announced by the U. S. Civil Service Commission. Full information and application blanks may be obtained from the Civil Service Commission at Washington, D. C., or the secretary of the Board of U. S. Civil Service Examiners at the postoffice in any city.

Assistant mechanical engineer (internal combustion engines), to fill vacancy in the Bureau of Aeronautics, entrance salary, $6.40 a day. Receipt of applications to close November 6th.

Junior mechanical engineer. To assist in experimental and research tests. Entrance salary, $5.04 a day. Examination to be held on November 7th.

Valuation engineer, to estimate quantity of oil, gas, coal or timber in place,market values, etc. Salaries, $3,600 to $4,800. Also associate valuation engineer; salaries, $3,000 to $3,600. Applications will be received until December 28th.

Junior engineer and deck officer. For vacancy in the Coast and Geodetic Survey. Entrance salary, $2,000 a year. Applications received until December 28th.

NEW YORK STATE CIVIL SERVICE EXAMINATIONS

The director of the Division of Sanitation, Department of Health of New York State, announces that examinations will be held on November 3rd for filling vacancies in two positions as assistant sanitary engineer, one carrying a salary of $3,000 to $3,500 and the other from $2,100 to $2,500. Both positions are open to non-residents. The former requires a knowledge of the design, construction, operation and supervision of water supply systems, water purification works, sewerage and sewage disposal systems; the principles of chemistry and bacteriology as applied to public water supplies, the principles governing stream pollution and its prevention, etc. The second position requires the making of investigations and reports on the construction and operation of water supplies and sewerage systems and water and sewage treatment works, and on stream pollution and sanitary conditions of summer camps and state institutions. The candidates for either position must be graduates of a course in civil or sanitary engineering at a technical school of recognized standing and must have had since graduation experience in engineering, which experience must have been in sanitary engineering extending over four years for the former position, one in the construction or operation of water or sewage treatment works, and have extended over two years for the second position, one of which must have been in sanitary engineering.

Street Cleaning in Newport

The street commissioner of Newport, R. I., John F. Sullivan, states that cleaning streets of that city was changed from the methods of the previous year because of the purchase of an Elgin sweeper. As described in PUBLIC WORKS for January 7, 1922, durable pavements were cleaned in 1921 by the use of 11 men and 3 carts, while 4 foremen, 29 men and 5 carts were employed on macadam streets and others not having durable pavements.

The 11 men and 3 carts were continued until February 21, 1922, and were then replaced by the use of the sweeper together with 4 men and one cart, which are known as a patrol, to clean the permanent pavement streets; the sweeper cleaning the pavements in the early morning while the patrol maintained them for the rest of the day.

"The operation of the Elgin sweeper," says Mr. Sullivan in his report, "also retired one of the season cleaning gangs consisting of one foreman, 6 men and 2 carts. The Bellevue avenue gang was reduced to 2 men and 1 cart, retiring 2 men. This small gang operated on Bellevue avenue from Touro street to Perry street during the summer season only.

"The appropriation for street cleaning was reduced $16,000, from $54,000 to $38,000, consequently it was necessary to make the above changes. The street sweeper has covered many of the asphalt macadam roads formerly swept by these men, making the cost of street sweeping more economical.

"The Elgin sweeper was purchased at a cost of $7,011 F. O. B. Newport, R. I., and has given very satisfactory service. This machine cleans all of the permanent pavements in the early morning and covers many of the asphalt macadam road beds later in the day."

The cost of operating the sweeper for the rest of the year following February 21, comprised $2,488 for labor, $552 for repairs, $357 for gasoline, $197 for oils and grease and $423 for brooms, etc.; giving a total of $4,016 for operating expenses. If we allow 20 per cent. for depreciation and 5 per cent. for interest, we have an added overhead of $1,753, giving a total annual cost of $5,769.

The report shows that the amount of cleaning of permanent pavements done to February 9th was 3,048,390 square yards at a cost of $2,170 or 71 cents per thousand square yards of cleaning.

Following February 9th, the motor sweeper cleaned 12,885,389 square yards, or 879.23 miles of permanent pavements at a cost of $4,016, as

stated above. The patrol covered 16,468,504 square yards during the same period, being to a large extent the same area covered by the motor sweeper, at a cost of $6,225. The Bellevue avenue gang cleaned 2,406,960 square yards at a cost of $1,498; while on all the other streets the cleaning amounted to 7,366,120 square yards and cost $23,920. Reducing these figures to cost per thousand square yards, we find the cost of motor sweeping was 31 cents, by patrol 38 cents, by Bellevue avenue gang 62 cents, and on the other streets without permanent pavements $3.25.

Among numerous other services, the street commissioner cleaned the catch basins connected with the sewerage system using 4 men in the cleaning gang. There were 502 catch basins in the city and these were cleaned 1,114 times, 923 loads of material being removed from them and in the 144 cleanings of "eyes"; the total cost of this cleaning being $5,631. This shows an average of each catch basin cleaned more than twice during the year and about 8/10 of a load of material removed on each cleaning, while the cost per cleaning was apparently somewhat less than $5.00.

Present Status in Refuse Disposal*

Present conditions less satisfactory than before the war. Reduction not remunerative, incineration more expensive. Other methods.

In many places those municipal wastes which are removed in a solid condition have become quite abnormal in character since the war. Not only do ashes contain less coal, but the organic wastes such as garbage contain much less fat and are more than ordinarily variable in quality and quantity.

In America, the reduction process for treating garbage on a commercial scale to obtain the grease has become of little practicability because of the low price and small quantity of grease in comparison with the cost of labor and the needed extractive. Furthermore, the dried solid residue or tankage finds no market, as was formerly the case, as a low-grade fertilizer or filler.

The low temperature incinerators requiring coal or other additional combustible for burning garbage are interfered with by the scarcity as well as the high price of coal.

The few high-temperature destructors in America are handicapped in varying degrees at different times and places by the comparative absence of combustibles.

More garbage than ever before is now sent with other refuse to the dumps and indifferently burned when weather permits. Considerable garbage is ploughed into the fields. Many sizable cities during and since the war have tried the plan of feeding garbage to pigs. But this arrangement in connection with short-term contracts has not proved nearly as satisfactory as in the New England states, where hog farms have been gradually developed through a term of years on a sizable scale to meet the needs of growing cities. Dissatisfaction has come in part from the low price of pork and partly from the complaints arising from objectionable conditions in the opinion of those living in the neighborhood of the hog farms.

New York City is barging its garbage to sea. This is not wholly satisfactory, as the harbor is somewhat littered at times by stray portions of garbage detached from the barges. Odors are complained of both from moving barges and those tied to the docks, especially when held there awaiting suitable weather for towing to the open sea. Furthermore, the wind and tides move some of the garbage to the bathing beaches along the neighboring coast.

Taking everything into account, it is fair to say that at present there is no problem in sanitary engineering in America that is being handled with less satisfaction to the citizens than that of garbage disposal.

At Frankfort, I found that the destructor plant has been out of service for three years, and the garbage is being ploughed into the ground. At Zurich this step is being considered, although the destructor is still in operation. The sale of electric current by the plant has dropped due to quality of the refuse and the increased cost of labor to twenty-two francs per eight hours has resulted in a deficit of about 125,000 francs per year instead of a surplus of 25,000 francs. This deficit is barely met from the surplus from the refuse collection department, for which there is a special tax of half a franc per room per month.

In other continental cities destructors have not been operating normally for some time. In Italy there are six or eight cities where the Beccari system is in use. It consists essentially in placing the garbage, after sorting, together with the street sweepings, into a closed concrete chamber, the single compartments of which have a capacity of about twenty-five cubic yards. At the end of thirty-five to forty-five days the organic wastes have become fermented so that they resemble humus which after screening is said to make an excellent fertilizer, selling for forty to fifty lira per one hundred kilos.

I visited the plant of this type at Florence which has been in operation for several years, serving about one-half of the city. It receives street sweepings, as well as garbage, and also some farmyard manure. There were very few flies except where the surplus refuse was stored in piles awaiting treatment in the overtaxed plant. Odors were practically absent except in a shed where they stored old bones removed from the garbage. The fermented product had no objectionable odor, and after screening resembled humus. On the screens were particles of unfermentable rubbish and resistant organic matter which it was said should be put into a cell again.

It was my understanding from the technical descriptions of this process that the fermentation was conducted on an oxydizing basis with air entering the

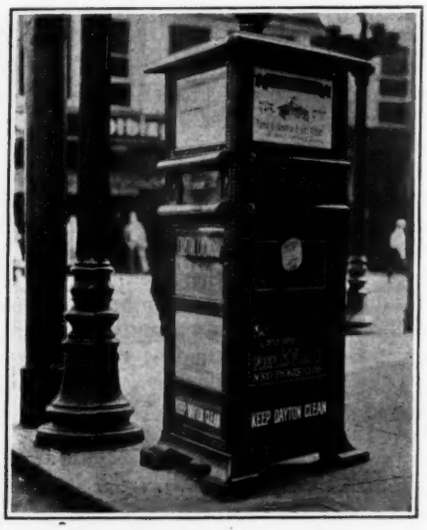
*Part of a paper on "Recent Developments in Sanitary Engineering," read by George W. Fuller before the Institute of Sanitary Engineers, England, on September 10th.

entire mass during the thirty-five to forty-five days during which the temperature rises to 140 to 180 degrees Fahr. But from my observations I should doubt whether the air penetrates the mass of garbage so as to maintain an aerobic fermentation. It seemed to be an anærobic or septic decomposition, with the air inlets in each corner of the cell simply serving to promote the removal of gas through a vent in the roofs of the cell, and on which is a tower with trays filled with soil and iron sulphate.

The Florence plant seems to furnish promising results, although lack of funds prevents it being doubled in size and provided with labor-saving mechanical equipment. I understand that a test plant has been erected at Paterson, N. J., about twenty miles west of New York. I am not informed as to results there obtained, but it seems to me that the first thing to do is to determine definitely whether the main body of material is fermented with the bacteria and other organisms working in the presence or absence of atmospheric oxygen. This seems essential to the suitable control of operations.

Dayton's Waste Paper Receptacles

Street receptacles for waste paper are being installed in the downtown districts of Dayton, Ohio, which promise to be successful financially as well as from the standpoint of service, the sides of the cabinet being utilized for displaying advertising matter under a franchise granted to two citizens of Dayton by the City Commission in December, 1922.



DAYTON'S NEW TRASH RECEPTACLE.

The ordinance provides that the cabinets shall be installed, and maintained clean and in repair for two years from February 1, 1923, at places designated by the city, the city to receive the sum of $50 per year for each cabinet installed. The owners derive their revenue from the sale of advertising space on the sides. The city reserves the right to control the character of the advertising, no political, theatrical, immoral or otherwise objectionable displays being permitted. During the period mentioned the city can purchase the cabinets at a price of $300 each less 10% for depreciation. Thus far no adverse comments or criticisms have been received and the only trouble found is that the cabinets are sometimes mistaken for mail boxes, $6,000 worth of bonds having been deposited in one of them by mistake.

They are installed and maintained under the supervision of the Department of Public Service, of which George F. Baker is director. The city empties the contents into wagons and removes it as it has always done with similar receptacles. They are generally emptied three times a week, early in the morning on Tuesday, Thursday and Saturday. The cost of collection is considerably less than the revenue received.

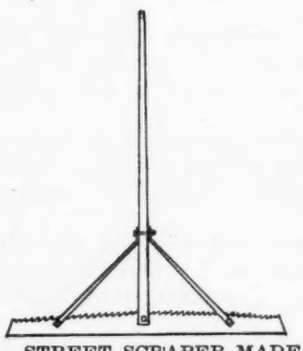
The cabinet is triangular in shape, about 30 inches on each side and 5 feet 6 inches high. It is of metal with embossed trimmings at the edges and between the advertising spaces, weighs about 300 pounds and is waterproof throughout. The base is of cast iron and the sides of bronze alloy. One space on each side is used for a city slogan, "Keep Dayton Clean." The other spaces, with the exception of those used for openings for receiving waste, are used for advertising, the placards being held in place by heavy glass plates. The rubbish receptacle, a triangular shaped metal can, is placed in the lower part and is removed for emptying through hinged doors which are locked when not in use. The upper part of the cabinet, also reached through locked doors, contains a police telephone and emergency kit. Red lamps, which can be used as a police signal system, are mounted on top of the cabinets, and two 40-watt 115-volt lamps with tube-like bulbs about 14 inches long are placed under the eaves on each side so as to illuminate the advertising.

Fifty of these cabinets have been arranged for by the city and at the time of our advice about a dozen had been installed.

Street Scrapers from Old Saws

At least three of the cities sending us street cleaning information use old saws in making scrapers for cleaning pavements. L. O. Parks, Superintendent of Streets of Talladega, Ala., one of the cities referred to, sends us a description and sketch of the way the scrapers are made in that city.

Discarded cross-cut saws are obtained for practically nothing and a local blacksmith furnishes and attaches handle and braces for $1.00, the handle being made from an old buggy shaft or some similar piece of wood. The back of the saw is used for the scraping edge. The ends are cut off at an angle so that the scraper can clean along the base of the curb.



STREET SCRAPER MADE OF OLD CROSS-CUT SAW.

The length of saw used is 6 ft.; the

handle is 6 ft. 6 in. long, and the braces are 2 ft. 6 in. long, of ⅞-in. flat iron. A slot is sawed into the larger end of the handle to receive the saw, and a hole is drilled through handle and saw to receive a bolt or rivet. One end of each brace is riveted to the saw, and through the other ends, bent up along the handle, as shown, another bolt is passed.

Mr. Parks says that the scraper serves the purpose well and is not inconveniently heavy.

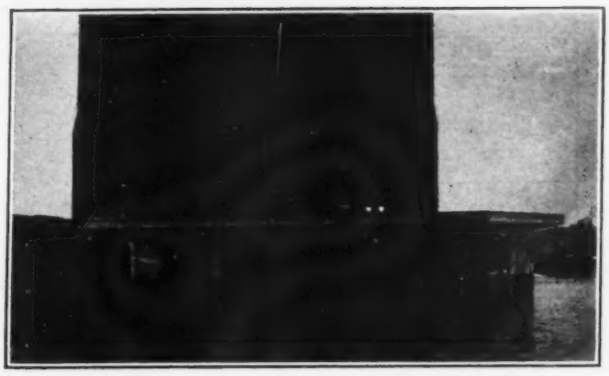
New York's Concrete Municipal Dump

By Frank W. Skinner

City will use, for dumping refuse onto scows, an elevated platform enclosing base of Brooklyn bridge tower, which affords 630 lineal feet of cantilevered dumping floor with easy approach and exit ramps.

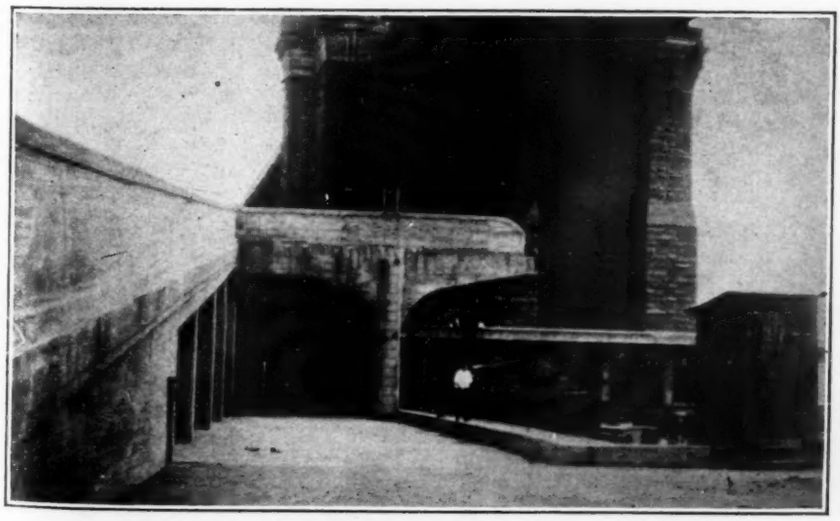
The concrete pier in the East River, at the foot of Roosevelt street, New York, is built entirely around the west tower of the Brooklyn Bridge and is connected to the shore by a section about 90 feet wide and 300 feet long, approximately perpendicular to the bulkhead line. It has a heavy reinforced concrete deck, carried on 933 16x16-inch piles, 46 to 80 feet long, which were pre-cast at the contractor's yard at Hunts Point, and driven by successively jetting with two 3-inch nozzles and setting to accurate position with a steam hammer at a maximum rate of twenty-five piles per day, as described in PUBLIC WORKS for December, 1922. The pier cost about $500,000 and was built by the George B. Spearin Company of New York City, which subsequently received the contract for constructing on it the dumping platform described in this article.

The dumping platform is intended to deliver excavated material, garbage and other refuse directly from trucks into dump scows moored to the substructure of the pier below the overhang in such a position that six scows can be loaded simultaneously by gravity without requiring any trimming or shifting of their loads, thus securing minimum expense and maximum rapidity of operation with very few attendants. It was designed for the Department of Docks by Major Henry Asserson, who adapted features of similar docks in Havana that had attracted the attention of former Commissioner of Docks Murray Hulburt.



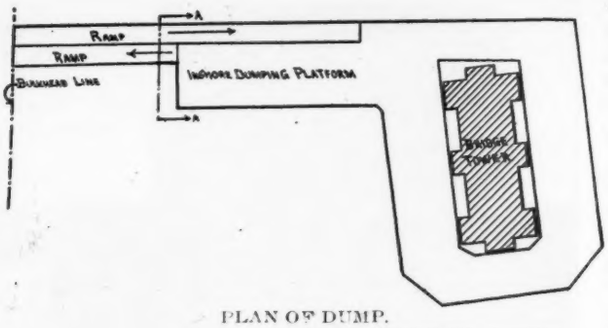
DUMPING PLATFORM ON RIVER SIDE OF TOWER.

The rectangular main portion of the dumping platform has a 150x225-foot horizontal floor completely enclosing the 59x140-foot bridge tower with a minimum clearance of 15 inches from it. This affords clear widths of 36 feet, 30 feet, 48 feet and 48 feet on the south, north, east and west side of the tower, respectively, the northwest corner of the platform being provided with a 64-foot wide extension, affording 150 lineal feet additional dumping space and connected with the ramp leading to the bulkhead line at South street. The total distance from the foot of the ramps to the river side of the dumping platform is about 430 feet. The main platform is horizontal, except that it pitches 3 inches from each side of the tower to the dumping edge, and is 27 feet above mean low-water. The incoming ramp, 275 feet long and 15 feet wide, has a grade of 2.8%, making it easy for the loaded trucks, while the outgoing ramp, 125 feet long and 15 feet wide, which is separated from it by a solid web concrete fence 5 feet high with panels 20 feet long and 6 inches in minimum thickness, has a steeper grade of 6.2% for the empty trucks.

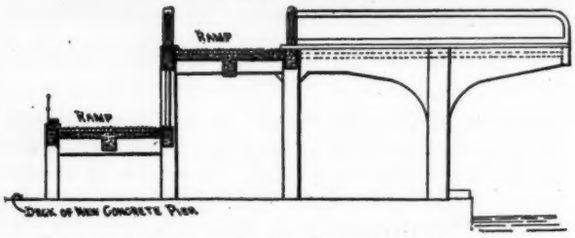


INSHORE DUMPING PLATFORM AND DESCENDING RAMP.

The floor slabs, 7 inches thick, proportioned for a maximum load of 500 pounds per square foot, are carried on longitudinal beams 6 or 7 feet apart and transverse girders, generally about 20 feet apart, that are supported on vertical columns from the deck of the main pier. The dumping platform has a total length of 631 feet, cantilevered 16 feet beyond the centers of the outside columns, and



PLAN OF DUMP.

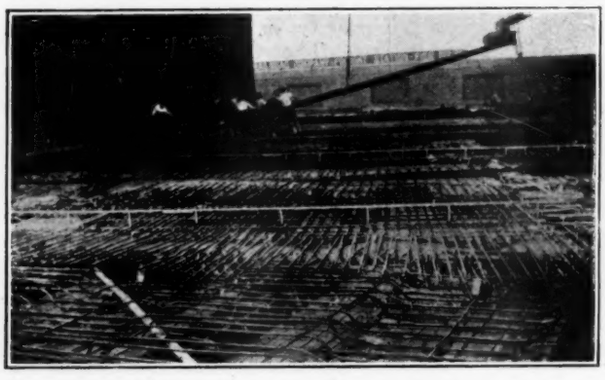


SECTION OF RAMPS AND PLATFORM AT A A.

terminates in a concrete curb and a 12x12-inch backing log securely bolted to it.

The cantilever girders supporting the overhang have solid-web knee-braces integral with the columns. All of the columns have rectangular cross-sections from 18 to 30 inches square with reinforcement varying from four ⅞-inch round bars to thirty-two 1-inch square bars. The inner side of the platform is protected by a pipe railing and is lighted by electric lamps on poles about 15 feet high. Ramps and platform are paved with granite blocks 5 inches thick laid on a 1-inch dry mortar bed.

The concrete was all mixed and placed by a floating plant installed on a 90x34-foot scow 8 feet deep, which was moored alongside and moved from place to place to command the entire area. The scow was equipped with a 1-yard Ransome mixer, a chain-belt conveyor delivering cement to the mixing platform and a 74-foot derrick boom supplying aggregate to the two 12-yard elevated storage bins. The concrete was hoisted in a 50-foot tower and spouted to a maximum distance of 66 feet by steel chutes carried by the tower boom. The concrete plant was operated by a force of about twenty-five men and had a maximum output of 300 yards in eight hours. The 2,800 yards of aggregate required were delivered by 500 to 700-yard barges that were moored alongside the mixer scow and unloaded by its derrick boom equipped with a clamshell bucket that filled the elevated storage bins.



CONCRETING FLOOR SLAB FROM FLOATING PLANT.

The principal quantities involved were 2,500 yards of concrete, 260 tons of corrugated bar reinforcement from ⅜ to 1⅛-inch square, and about 200,000 feet, board measure, of lumber for the 110,000 square feet of form surface, about three-fourths of the forms being erected at one time. Operations were commenced April 1st and finished about August 1st with a maximum force of 100 men under the direction of R. D. Love, superintendent for the contractor.

Refuse Reclamation at Halifax

Fertilizer and gas to be manufactured and the latter used for creating power.

The town of Halifax proposes to reclaim all its refuse and has applied to the Ministry of Health for permission to borrow 15,111 pounds for constructing a plant. At present the refuse, amounting to about 22,000 tons annually, is placed on dumps. From information furnished by W. H. Sagar, the cleansing superintendent, to "Municipal Engineering" of London, we obtain the following information concerning the plant:

Halifax has a population of just over 100,000. The city is by no means thoroughly sewered, as there are still 16,000 pail closets in use, and it is proposed to utilize the contents in producing fertilizer in connection with screenings from the refuse.

There will be a screen 18 feet long by 5 feet in diameter, the first 12 feet containing ¼-inch or 5/16-inch wire mesh and the remaining 6 feet, 1½-inch mesh. To allow for a variation of moisture in the refuse, so that damp material can be given a longer screening than that which is dry, the screen is designed with a tilting arrangement allowing it to assume any angle with the horizontal up to 12 degrees, the angle being variable while the screen is in motion. The dust coming through the fine mesh will fall into a small hopper and will be carried about 100 feet by means of a pneumatic suction plant operated by a 15-horsepower motor which will draw the dust through a 4-inch pipe and deposit it in a hopper immediately over a pug mill in which it will be mixed with the contents of the pail closets. The pail material will be deposited in a sealed concrete tank, from which it will be drawn by a centrifugal pump and lifted into the pug mill where it will be mixed with the dust from the screen. This pug mill is a U-shape trough about 6 feet long with two parallel shafts, each carrying small knives which revolve in opposite directions. The mixture falls on to a belt conveyor by which it is carried direct to a railway car for transportation.

Probably the most novel feature of the proposed plant is the vegablegas producer by which it is proposed to make gas from the refuse. Mr. Sagar says that if the working plant produces 75% the efficiency of the test plant, it will be successful. From tests made by charging the producer with a light combustible matter such as paper, rags, carpet, oilcloth, banana stalks, straw and general market refuse, 47,000 cubic feet of gas was produced per ton of refuse with an average calorific value of 130 b.t.u. per cubic foot. After passing the gas through a cascade scrubber, extracting the tar, and then through a dry scrubber in a manner similar to that employed for coal gas, the gas is passed to a double mixing box in front of a boiler which stands on three castiron cradles and requires no brickwork. The boiler is 21 feet long by 5 feet 6 inches diameter and contains 172 tubes which run the full length of the boiler and give a heating surface of 1,500 square feet. Opposite each tube and about 3 or 4 inches from it is a burner, from which the flame passes into the tube and is drawn through it by an induction fan placed at the chimney end of the boiler. The combustion is so complete that only a 30-foot steel chimney 10 inches in diameter is required to carry away the fumes. The evaporation test has shown 3 pounds of water per pound of fuel from and at 212 degrees. The boiler is capable of producing 8,250 pounds of steam per hour. The steam will be used to drive a 225-horsepower vertical compound engine with a direct coupled alternator, which will produce power for driving the salvage plant and the fish plant, with a surplus for lighting the premises and other purposes. The residue from the consumption of the refuse will consist of a white ash containing a good percentage of potash which will be mixed with the dust for enriching the fertilizer.

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EFFECT OF EARTHQUAKE IN JAPAN.

The above photograph was taken in the Customs Compound at Yokohama, looking toward the harbor. The block pavement on the left shows pronounced waves in longitudinal profile; while that on the right, which looks like bituminous concrete, has apparently settled into a crevasse or furrow.

Lynchburg's Public Works Report

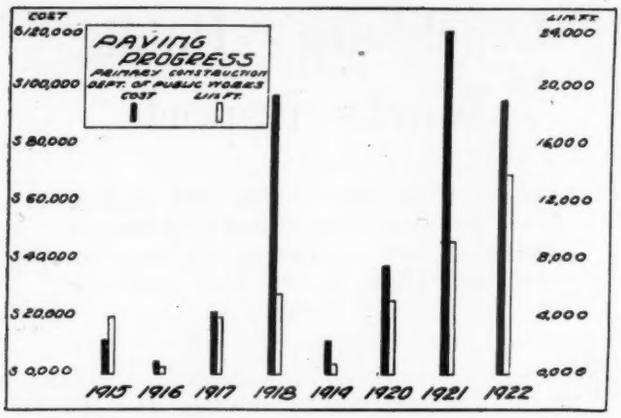
O'd brick pavement relaid with asphalt filler. Economy in improved maintenance methods. New appliances for cleaning and sprinkling streets and removing snow.

The annual report of the city of Lynchburg, Va., for the year ending January 31, 1923, is a most creditable pamphlet in attractiveness of appearance, in manner of presenting the facts and in the facts themselves. The ninety-three pages of heavy coated paper, inside a most artistic cover, contain 23 reproductions of photographs and 11 diagrams, which must greatly aid in giving the taxpayers a clear understanding of the most important statistics of the city's functioning.

The message of Mayor Fred Harper pays a high tribute to the city manager, E. A. Beck, who has charge of practically all the municipal operations except those connected with the schools, finances and law. The expenditures totaled $620,124 for general operation and $227,208 for capital outlay; the total disbursements being $1,778,407. Some of the more interesting items of the report of the Department of Public Works are given below.

A distance of 1,055 feet of Madison street was repaved by city forces. The old pavement was brick 46 feet wide laid in 1892. The bricks were taken up, cleaned, sorted, and relaid. The pavement was narrowed to 27 feet, leaving 9½ feet on each side for a parkway. As the area of the new pavement was but 60 per cent. that of the old, sufficient old brick were available to repave and also to lay a block of roadway elsewhere. The brick were laid with asphalt filler on a concrete base. The entire cost, including additions to storm and sanitary sewer systems, was $10,835.

The paving of four miles of dirt streets, together with economies resulting from improvements in methods of maintenance, substantially decreased the cost of upkeep of unpaved streets, or from $18,058 the year before to $11,846 in 1922. The work done on unpaved streets comprised dragging 2,643 blocks, grading and shaping 246 blocks, cinder surface on 148 blocks, and constructing 44



ONE OF THE CHARTS IN LYNCHBURG'S REPORT.

inlets and 5 pipe drains. Of the total cost, $11,846, $1,054 was for material and the rest for labor. In addition there should be charged against this work $4,318 for teams and trucks furnished by the city garages and stables.

The paved streets are of slag macadam, asphalt macadam, brick, concrete, rubble and cobble. Of the first, 30,440 square yards were laid last year at a cost of $14,766, or 48.5 cents per square yard. Of the total area of 216,200 square yards of asphalt macadam, 66,282 square yards was reconstructed or resurfaced at a cost of 20 cents per square yard.

The Bureau of Street Cleaning swept 2,006 blocks in the business district at night, removing 300 loads of sweepings at an average cost of $1.62 per block, while hand sweeping during the day on the same area cost $2,248. Mechanical sweeping of the residential and semi-business sections cost $9,797, 9,756 blocks being swept and 2,577 loads of sweepings removed. These costs include "value of time of teams and trucks furnished by city stables and garage," totaling $5,273.

In June, the department assembled a motor driven combined sprinkling and sweeping unit by adding sprinkler equipment to a sweeper and attaching a Fordson tractor to it. This replaced an outfit consisting of an independent sprinkler and sweeper, each drawn by 3 horses, and reduced the average cost of mechanical sweeping 35c per block.

During one storm at the close of January 1922, snow fell to a depth of 20.3", the greatest within the 30 years during which official weather records have been maintained. Although all traffic lines within the city were cleared within 36 hours, this experience impressed the need of mechanical equipment for such an emergency. The department shops therefore designed and constructed a snow plow for operation in front of a 3½-ton motor truck. During later snows this equipment cleared the streets (both sides) at the rate of a mile an hour.

REPAVING BRICK STREET BY CITY FORCES IN 1922.

Garbage Disposal in Kansas

Data concerning fuel disposal have been obtained from Kansas cities of the first and second class and compiled by Harvey Walker, assistant secretary of the League of Kansas Municipalities, and this information was published recently in the organ of that League. From this we abstract the following information concerning the disposition made of garbage by these cities.

Inquiries were sent to 87 cities of the first and second class in the state of Kansas. Eleven failed to report or gave no definite information on the subject, while 39 reported that they had no system of garbage disposal. Of the remaining 37, 28 disposed of garbage by feeding it to hogs. In all but one or possibly two cases the hogs were privately owned, and in the majority of cases the garbage was collected by the hog owners, although in a few of the cities it was collected either by city employees or by parties under contract with the city.

Of the remaining 9 cities, 4 hauled the garbage to dumps, 2 burned it, and 3 buried it, 2 of the last reporting burning that which was readily combustible. Apparently none of the burning was done in incinerators but only in the open.

Paving in New York State

The amount of paving done by the New York State Highway Commission will probably exceed 3,000,000 square yards this season. At the height of the season approximately 1,000,000 square yards per month were being laid under more than 200 contracts on which nearly 7,000 men were employed. The maintenance force employed by the state numbered over 4,800.

Longest Straight Street in the World

Philadelphia claims to have the longest paved street in a continuous tangent to be found in the world. This is Broad street, which is 13.8 miles long and varies in width from 113 to 300 feet, all of which has been paved except one small strip and paving on this probably will not be delayed much longer.

Highway Revenues in Kentucky

The secretary of the State Tax Commission of Kentucky reports that during the fiscal year recently ended the revenue from the 1 cent gasoline tax totaled $586,188.50, which was an increase of approximately 25 per cent over that of the previous year. The revenue from this tax accrues to the state road fund.

Refuse Disposal in Chicago

Improvement and extension of reduction plant. Amount and cost of collection of ashes and rubbish and of street cleaning and snow removal.

The latest annual report of Thomas H. Byrne, superintendent of streets of Chicago, shows that during the year covered by the report the city collected 107,292 tons of garbage at a cost of $503,932 for collecting and hauling, $20,524 for handling at loading stations and $73,404 for boat hire; a total of $597,860, or $5.57 a ton, or 21c per capita. This material was delivered to the reduction plant, some by boat from loading stations and some by direct haul.

Due to the installation of a new dryer equipment, garbage grease was not produced during the first five months of the year and very little tankage was manufactured; 1,143 cars, containing 40,660 tons of dry garbage and refuse, being shipped from the municipal reduction plant to Hawthorne for disposal. During the remaining seven months the plant produced 3,118;640 pounds of garbage grease, or 2.2% of the weight of garbage, and 7,192 tons of tankage, or 8% of the weight of garbage.

Eugene Vollmar, foreman of the Bureau of Waste Disposal, reported that the reconstruction of the plant has placed it in a first-class operating condition to manufacture garbage grease and garbage tankage, placing in operation three revolving percolators in the new extraction plant and four Page-Burton boilers in the new boiler house, which equipment was installed five years ago. In addition, the plant now has six new direct heat primary dryers and furnaces, two new indirect heat finishing dryers with new transmission, five new percolators in the old extraction plant, two new pulverizers in the receiving building, six exhaust fans in the No. 1 dryer building, a 20-ton locomotive crane, a 20-ton truck scale, two steel breechings, together with new conveyors and other machinery.

The net cost of operation, including repairs and removal of rubbish, was $530,857, or $5.10 per ton. This was obtained by deducting from the total operating expenses the total revenue obtained by the sale of by-products, the latter corrected by a comparison of the inventories at the beginning and end of the year. However, considering only the last seven months, after the improved plant was in operation, the operating cost was $5.93 per ton, revenue $1.79, and net cost $4.14. Garbage grease was sold at 3.3c per pound, animal grease at 5c per pound, calfskins at 9.42c per pound, tankage at $4.95 per ton, rags at $3.89 per ton, bones at $20 per ton, scrap iron at $4.32 per ton and other trade wastes at $10 per ton. The operating expenses consisted of $382,403 for salaries and wages, $66,342 for fuel oil, $14,012 for power, $1,565 for light, $66,204 for coal, $93,515 for supplies and repairs and $36,327 for removal of dried garbage and rubbish. An average of 230 men were employed at the plant throughout the year, a number which "made it possible to dispose of the garbage without overtime and to close the plant one day per week in addition to Sundays and holidays for about thirty weeks when the receipts were insufficient for full-time operation."

The amount of raw garbage received varied from a minimum of 5,569 tons during February to a maximum of 12,660 tons during September. The total amount for the year was 3.31% greater than during the preceding year.

The Bureau of Streets collected and hauled to the city dumps 2,011,948 cubic yards of ashes and miscelloneous waste, of which 232,879 cubic yards was collected and hauled by auto trucks. Also 17,043 cubic yards was spread by hand in alleys that were below grade. The cost of collecting and hauling was $2,236,239 and the cost of maintaining the city dumps was $101,566. The total give a cost per cubic yard of $1.16, or 81¾c per capita.

The area of streets cleaned, using the block and gang system, totalled 2,815,393,914 square yards. From this area 338,615 cubic yards of dirt was collected, of which 3,598 cubic yards was dumped on low ground. This work cost, for labor and teams, $1,775,132, for material and supplies $23,298, and $3,407 for hauling street dirt in railroad cars. This gives a total of 64c per thousand square yards cleaned, or 63c per capita.

In addition, 91,826,463 square yards of alleys were swept and cleaned at a cost of $58,779 and 4,311,788 square yards of weeds were cut at a cost of $7,077. Auto flushers in the First Ward flushed and cleaned 100,291,686 square yards of streets, using 22,005,300 gallons of water, the cost of this being $7,302 for drivers, helpers and labor and $1,958 for gas, oil and repairs, an average of 9c per thousand square yards. Horse-drawn flushers in the First Ward cleaned 14,443,139 square yards, using 4,868,000 gallons of water, the cost being $6,532. Auto flushers working in all the other wards cleaned 261,270,987 square yards of streets, using 68,653,200 gallons of water, the cost being $19,123 for drivers and helpers and $4,391 for gas, oil and repairs, giving an average of 9c per thousand square yards. Auto sweepers cleaned 37,923,732 square yards of streets at a cost of $4,901 for drivers and helpers and $2,498 for gas, oil and repairs, an average of 19½c per thousand square yards.

Snow removal in the First Ward cost $11,747, 5,104 cubic yards being removed from 5,315,676 square yards of streets. In all the other wards 2,479 cubic yards of snow was removed from 1,863,112 square yards of streets at a cost of $5,371.

Flood Protection in San Antonio

Preliminary data are being collected and plans prepared for the construction of flood protection works for a portion of San Antonio, Texas, preliminary

estimates indicating a cost of about $5,500,000. The flood prevention work contemplated consists of a concrete retention dam approximately 2,200 feet long to cost about 2¼ million dollars; the widening and straightening of the channel of the San Antonio river and its tributaries, to cost approximately 1¼ million dollars; and the reconstruction of bridges and other public improvements made necessary by the channel changes, which will cost approximately 1½ million dollars.

In addition to this, the city proposes to spend about 2 million dollars for paving, sewers and parks. D. D. Harrigan, city engineer of San Antonio, has been in charge of all of the investigations and surveys made in connection with this work.

Referendum in Reforestration

The Chamber of Commerce of the United States is taking a referendum of the more than 1,200 organizations in its membership on the subject of national forestry, eight points being submitted for expression of opinion. These are in the form of recommendations calling for Federal and state action as follows:

That the Federal Government acquire, re-seed and replant waste lands where forests will not grow by natural means and to the extent permitted by law; that states and municipalities take similar action on land where the Federal Government cannot act; that Congress provide for similar treatment of other classes of timber-land by cooperation of the Federal and State Governments and timber owners in protection and reproduction of timber; that Federal funds be contributed only to states that have a forestry or conservation commission, that formulate a code of forest management, maintain adequate protection of the timber-lands from fire (funds from state and private sources to at least equal the Federal appropriation), and that base taxation of growing timber on the principle of the yield tax; that Congress create a national forest council containing representatives of the public, timber men and foresters; that Congress provide for a national survey and inventory of forest resources; that it increase the Federal appropriations available for protection of timber-land against fire; and that it provide for enlargement of Federal research and experiment in forest products. Two members of the Chamber of Commerce Committee that formulated the referendum disapproved of the recommendation for the creation of a national forest council.

New England Waterworks Convention

The Forty-second annual convention of the New England Waterworks Association was held in Burlington, Vermont, September 18th to 21st, at the Hotel Van Ness. The exhibits were on the ground floor adjacent to the secretary's office while the meetings were held on the floor above. The attendance by Wednesday night included 130 active members, 86 associates and 175 guests. In spite of the counter attractions of golf and the beautiful country in and around Burlington, the seating capacity of the hall which was 88, was on a few occasions exceeded by the attendance, while it was perhaps two-thirds filled during most of the sessions.

The morning, afternoon and evening sessions of Wednesday, Thursday evening and Friday morning were occupied with the reading and discussion of papers; on Tuesday afternoon occurred the opening addresses and the reading of one paper. The diversions consisted of a trip to Fort Ethan Allen on Tuesday afternoon and a reception and dance that evening; an all-day excursion to Ausable Chasm on Thursday, and golf throughout the week. Teas, whist parties, an automobile trip, etc., were provided for the ladies. The weather was excellent throughout the convention except for light rain on Friday which inconvenienced only the golfers.

The report of Secretary Gifford showed a net loss of 59 in the membership during the eight months from January 1st to September 1st, the association year having been changed from the former to the latter date in accordance with recent changes in the constitution. The membership September 1st was 769, which was 274 less than it had been six years previous. Some of this year's loss was due to the dropping of members for non-payment of dues, and it is hoped that some of these will be restored to membership.

In spite of the decrease in membership, the finances of the society are in good condition, the report of Treasurer Winslow showing a considerable balance in both ready cash and invested funds. The net cost of publishing the journal was $341 and the amount paid for rental of the society quarters in Tremont Temple and the assistant secretary was $1,983. For some years previous these last two items had cost $1,950, before the society became one of the affiliated technical societies of Boston. President Sanders, in his address, referred to this fact, stating that since the affiliation the assistant secretary has been the clerk of the affiliated technical societies and has been paid by the organization, while the association pays to the organization $3 per member, adjusted for duplicate membership.

The teller of elections, Henry T. Gidley, announced that 249 votes had been cast, David A Heffernan, superintendent of waterworks of Milton, Mass., receiving 246 votes for president; Theodore L. Bristol, of Ansonia, Conn., 244 for vice president and Stephen H. Taylor of New Bedford, Mass., 242 for vice president, Mr. Bristol to serve two years, and Mr. Taylor, one year; for directors to serve two years, George A. Carpenter, of Pawtucket,

R. I., received 242 votes and Arthur E. Blackmer, of Plymouth, mass., 232 votes, while for a one-year term, George W. Batchelder, of Worcester, Mass., received 244 votes, and Frank Emerson, of Peabody, Mass., 227 votes. Frederic I. Winslow was reelected treasurer. All of these were the nominees whose names appeared on the official ballot.

Honorary membership in the association was conferred upon John R. Freeman, the presentation being made by Charles W. Sherman and accepted by Caleb M. Saville as representing Mr. Freeman who was unavoidably absent. Following this, the Dexter Brackett Medal for 1922 was conferred upon Charles W. Sherman for his paper entitled, "Bond Issues—Over What Period Should They Run?" the medal being presented by Frank A. Barbour.

TUESDAY'S SESSION

The convention opened on Tuesday afternoon with a welcome to the association by J. Holmes Jackson, mayor of Burlington, and C. S. Ordway, president of the Burlington Chamber of Commerce, reply being made by President Sanders. The opening session concluded with a paper by Oliver J. Channing, pumping engineer of Burlington, describing the filtration of Burlington's water. The paper dealt more with the results than the method. Mr. Channing stated that during the period 1904 to 1908 there were 151 cases of typhoid, although the intake was two miles out from the shore in Lake Champlain. Mechanical filters were introduced in 1908 and in the two years 1909 and 1910 there were 29 cases of typhoid. In December, 1910, the city began using hypochlorite and in 1911 there were only 7 cases of typhoid, 6 of these being traced to out-of-town sources. Liquid chlorine was substituted for hypochlorite in 1921, and in 1922 there was but one case of typhoid in the city. Some discussion followed. G. H. Pratt, of Wallace & Tiernan, stated that chlorination generally cost about 50 to 60c per million gallons, while the least expensive installation cost about $600 and the largest units up to $1,500 or $1,600 each.

WEDNESDAY'S SESSIONS

Wednesday morning's session opened promptly (as, in fact, did all of the sessions of the convention) with a paper by Charles P. Moat, chemist of the Vermont State Board of Health, who described the "Public Water Supplies of Vermont." A supply is considered public in that state if there are 10 or more consumers. There are 106 such supplies in the state and about 50 vacation camps. Mr. Moat described the outstanding features of many of the supplies, especially as to their quality. Most of them are from surface sources and most of these should be chlorinated but only a few are. Vergennes uses a badly polluted supply and suffers considerable typhoid in consequence but has so far refused to adopt any precautions urged by the State Board. One interesting statement of Mr. Moat's paper was that B. coli had been traced conclusively to deer droppings on the watershed of one of the supplies.

A paper written by Edwin H. Rogers, city engineer of Newton, Mass., entitled "Sub-surface Collecting System and Quality of Water of Newton, Mass.," was read by the secretary in the absence of Mr. Rogers. In this paper Mr. Rogers described the obtaining of the supply from galleries near the river and wells and stated that so far there had been no trouble with diminishing amount nor with increasing content of iron or other minerals in spite of the increased draft. There was no discussion of this paper.

Another paper was read by Robert Spurr Weston in the absence of the authors, George C. Bunker and August G. Nolte, the former in charge and the latter assistant engineer in charge of water purification on the Panama Canal, the paper being entitled, "The Covering of Open Service Reservoirs in Which Filtered or Ground Waters Are Stored." The authors believed that in practically every case such reservoirs will ultimately have to be covered, since trouble with such water if not covered almost invariably occurred, and it was much cheaper to construct the covers when the balance of the reservoir was constructed than to add it later. Supporting the contention that trouble occurred with open reservoirs, the paper referred to the open reservoirs at St. Louis which had been giving trouble for more than seven years and for covers for which Commissioner Wall has yearly been asking several hundred thousand dollars. This paper was illustrated with a number of slides.

The session concluded with Allen Hazen's paper entitled "Some Additions to New England's Waterworks Plants," which also was read in the absence of the author, Mr. Pirnie substituting for Mr. Hazen. In this paper Mr. Hazen described briefly improvements at New Britain, Connecticut, where impounding reservoirs have been built to utilize the entire surface yielding of the drainage area and in addition wells have been installed; at Springfield, Mass., a duplicate slow sand filter plant is being constructed, doubling the capacity; Providence, R. I., is completing its new gravity supply and studies are being made for filtration of it, it being probable that mechanical filtration will be employed both because of the amount of color in the water and of the lack of available area for slow sand filters; it being proposed also to aerate both before and after filtration to remove taste and odor and also reduce carbonic acid and avoid red water troubles. Included in the paper, although not in New England, were Albany and Poughkeepesie, New York, both of which have filtration plants with double treatment, scrubbers being used. The Albany plant has been demoralized and the scrubbers become badly clogged and an entire overhauling is necessary, although ultimately a supply will probably be obtained from some source more favorable than the Hudson river.

In the afternoon Frederick I. Winslow of Framingham, Mass., discussed the subject of the "Care of Large Watersheds," this including tree planting and forestry, sanitary control and other features of the care of the watersheds of the Boston Metropolitan District. He recommended white pine for planting, commenting upon which in the discussion Mr. Diven stated that the Conservation Commission of New York advised red pine instead of white because of the white pine blister. It was believed however that by thoroughly eliminating gooseberry and currant bushes for an area of at least 500 feet from the trees, the blister could be prevented. Mr. Weston stated that the Scotch pine had given excellent results on

MEMBERS AND GUESTS AT THE FORTY-SECOND CONVENTION OF THE NEW ENGLAND WATER WORKS ASSOCIATION TAKEN AT PORT KENT, JUST AFTER LANDING FROM THE STEAMER TICONDEROGA, ON THEIR WAY TO THE AUSABLE CHASM.

the Pequannock shed. In Haverhill, Mass., according to A. L. Sawyer, good success was had with both white and Scotch pine. Boating and fishing were strictly prohibited on the reservoirs of this city.

A series of papers describing the new filter plant of Cambridge, Mass., was then read, Col. George A. Johnson reading the principal one entitled "Rapid Sand Filtration at Cambridge," followed by Mr. Stevens, who described the construction details and read a paper by Mr. Smulski describing the system of reinforcement used in the flat slab roofs over the filters, and finally one by ex-Mayor Goode dealing with the operation of plant. This plant was said by Mr. Johnson to be the first rapid sand filter plant in the state of Massachusetts, in addition to which it also contained several unusual features, although in the main it followed standard practice. The capacity was 14,000,000 gallons a day. The wash water is returned to the sedimentation basin, taking with it all of the suspended matter and thus conserving the water. The water is chlorinated after filtration. In the discussion, W. C. Hawley said that in the filters of his company, built in 1909-1910, the wash water is returned to the sedimentation basin but is first partly clarified in a separate settling basin, the result of this being a loss in washing filters of only 0.1% of the amount of water filtered. The wash water after settling was found to be better than the raw water with which it mingled in the sedimentation basin. Mr. Saville gave some facts with reference to the Hartford filters, referring to a friendly discussion between himself and Mr. Johnson relative to the cost of operation of that plant.

The final paper of the afternoon session was one by Harry U. Fuller, chief engineer of the Portland Water District, in which he described the laying of a 16-inch cast-iron water main under Portland's harbor. Mr. Fuller was given a vote of thanks for the paper since he was not a member of the Society. The method used was somewhat similar to that employed by New York City in laying pipe across the Narrows to Staten Island, a large wooden cradle being used down which the pipe slid into a trench previously excavated for it, the joints being made above water, every third joint being a flexible joint similar to those used by the Boston Metropolitan District. One of the questions arising in preparing the plans was whether the pipe would freeze in the cold weather of Maine, the harbor water frequently reaching the temperature of 23 degrees in winter. However, cans of fresh water buried in the salt water marshes along the shore with a 6-inch covering did not freeze and, as it was proposed to give this pipe a 3-foot covering, it was believed that there would be no difficulty from this cause. In crossing the channel the greatest speed was necessary to prevent holding up traffic and sixteen lengths of pipe were laid in ten hours, which was the maximum speed attained.

In the evening Frank A. Mazzur, mechanical engineer of Boston, read a paper entitled "The Selection of Pumping Equipment from the Standpoint of Station Economy." This paper was highly commended and we expect to publish it in an early issue. Mr. Mazzur compared a crank and flywheel high-duty engine, with a duty of 124,000,000 but with high cost, with a steam turbine centrifugal of low cost and requiring small area but with a duty of not over 100,000,000; also with an electric drive, which is not generally economical as an addition to a steam plant. The Diesel oil engine has been improved much since before the war in dependability and economy, and the duties now are greater than that of any steam pump. In general, Mr. Mazzur considered the oil engine as the most economical, especially in fuel cost. There was considerable discussion of this paper and numerous questions asked, most of the speakers agreeing that the Diesel engine was deserving of the high opinion expressed by Mr. Mazzur. One or two speakers expressed the opinion that the saving often claimed for the electrically driven pump in not requiring the presence of an attendant was not found to work out in practice, most plants furnishing an attendant.

George W. Batchelder, water commissioner of Worcester, Mass., described the reservoirs of that city, present and proposed, there being nine such reservoirs, which were shown by lantern slides. He stated that fifteen men are employed in maintaining them. Incidentally he remarked that during the winter, hydrants are inspected once every four days.

"Some Applications of the Venturi Principle" were described by Frederick N. Connet, chief engineer of the Builders Iron Foundry. Mr. Connet described uses that were common in waterworks plants and also a number that were possible but not yet in common use. He stated that Venturi meters could be used to advantage at ten different points in a mechanical filter plant.

THURSDAY EVENING

Thursday evening was set aside as superintendents' session and was opened with a paper by Frank A. Marston on "Hydrant Connections for Fire Engines," referring especially to the desirability of the 4½-inch connection. One strong argument in favor of supplying such connections on fire hydrants is that they are called for by the Underwriters Association. Mr. Hawley stated, however, that where pressures were high he was afraid of the 4½-inch connection. Instances were given of fire hydrants that were shaken loose from their connection by vibration due to a discharge through a 4½-inch connection. Mr. Marston said that considerable trouble had been found with water hammer or vibration in the use of such connection in Boston but almost invariably with a certain steam fire engine using a reciprocating pump.

A discussion followed covering various points connected with fire hydrants, some of the superintendents stating that in their cities one or more men connected with the waterworks department are carried as call men in the fire department and are supposed to be on hand to aid the firemen in the opening and closing of hydrants or in case of any other difficulty with the water supply.

Sydney Lee Ruggles, city engineer of Barre, Vermont, then described and illustrated on the screen experiences in eliminating water hammer from a high pressure regulating valve and also in laying Universal pipe on curves, with lantern slides showing such pipe laid on curves of about 200-foot radius without difficulty.

There followed a series of discussions on questions that had been suggested, these including

"Standardization of Water Meter Registers," "Use of Brass Pipe for Services," "Protection of Watermains Crossing Bridges," "Should Valve Boxes Be Placed at the Main or the Curb?" Discussion of the remaining questions was prevented by the lateness of the hour.

The subject of "Water Meter Registers" was introduced by Mr. Hawley, who stated that a water company in his district, in preparing to send to consumers cards with illustrations of dials and instructions for reading water meters, found that there were great variations in the arrangement of dials, some reading from left to right and others from right to left and that this difference was the cause of considerable confusion.He suggested that it would be a good plan to standardize water meter dials and it was decided by the members to revive the Committee on Meter Standardization and instruct it to cooperate with a similar committee of the American Waterworks Association in an effort to agree upon a standard form for meter registers; R. K. Blanchard of the Meter Manufacturers Committee stating that the manufacturers would be only too glad to adopt a standard instead of the eleven different styles now in use, if the societies would agree on what they wanted.

When the subject of brass pipe for services was discussed, Mr. Heffernan expressed the opinion that the cost of these would be prohibitive, to which Mr. Diven replied that the cost was about that of 2-A lead pipe. Several other members discussed the matter of services, including those of steel and of iron.

Concerning the necessity of protecting watermains crossing bridges, most of those speaking seemed to think there was little danger of freezing where there was circulation of water through the pipe, although one or two members described constructions employed by them for protecting pipe.

The question, "Should valve boxes be placed at the main or the curb?" seemed to be generally considered an unnecessary one, as no instance of service valve boxes in the street could be cited except in Worcester, Mass., and no very logical defense of the practice even there was presented.

FRIDAY'S SESSIONS

Friday was Manufacturers Day, the morning session being devoted to papers by manufacturers describing some features of their products or the use of them. Three reels of moving pictures were shown by A. A. Gatheman by which an excellent idea was given of the manufacture of wrought iron pipe in the A. M. Byers Company's plant. It had been proposed to show the manufacture of steel pipe by the National Tube Company, a paper with slides being down on the program for the afternoon, but it was decided to postpone this to a later meeting.

Payne Dean of Payne Dean, Ltd., gave a talk on "Testing, Maintenance and Operation of Large Gate Valves," in which he cited instances where the necessity of hand operation of these valves occasioned risk to property and lives, while it always involved hours of hard labor, which could be avoided by the use of a valve-operating truck which operated such valve by motor, or by the electrical control system for closing valves at a distance.

Under the title of "Records of Stream Flow; their Use and the Best Methods for Obtaining Them for Municipal and Industrial Purposes," C. C. Covert of W. & L. E. Gurley, described methods employed for obtaining such records, chiefly those of the U. S. Geological Survey, the paper being very similar to one read this year before the American Waterworks Association.

The last paper of the convention was one by Gilbert H. Pratt of the Wallace & Tiernan Company, describing some of the latest developments in chlorine control apparatus. Mr. Pratt illustrated his talk with lantern slides, showing among others the largest chlorination plant in the world, being the one at the Cleveland sewage treatment plant, which has a capacity of feeding 8 tons of chlorine in 24 hours to the sewage effluent before discharging into the lake.

Only a few attended the afternoon session, which consisted of the reading of the reports of the secretary, treasurer and editor and the president's address.

Short Courses in Highway Engineering

The University of Michigan announces the schedule of graduate short period courses in highway engineering and highway transport for the winter of 1923-24. Attendance on this course has steadily increased from 29 four years ago to 110 last winter. The average age of the men in attendance last winter was 27 years, varying from 23 to 56. They came from state, county and municipal highway departments, the U. S. Bureau of Public Roads, the offices of engineers and contractors, university faculties, companies manufacturing motor trucks and highway machinery and materials and the field of highway transport.

The course is divided into seven parts of two weeks each, beginning Dec. 3d and ending March 14th, with four days, February 11th to 14th, devoted to the Tenth Annual Michigan Conference on Highway Engineering. The several subjects will be in charge of Professors Blanchard, Swinton, Bateman, Riggs, Worley, Gram, Cissel and Lay.

Highway Patrol in Pennsylvania

Under the present law any of the 10,000 employees of the Pennsylvania State Highway Department can be deputized by the Secretary to serve notice on violators of the traffic rules and State troopers are now training nearly 100 men of the highway patrol in the methods used by special police. With the aid of these, an effort will be made to make the highways of Pennsylvania unsafe places for violators of the law.

Some of the infractions of highway regulations which the highway patrol will specially look out for are: Parking along improved sections of the state highways; passing other vehicles on hills and curves; lamps out of focus or with high candlepower; overloaded trucks; unlicensed operators; drivers who prevent operation of two-way traffic, and those who drive while under the influence of liquor. The Highway Department will revoke the license of drivers where the violation is sufficiently serious.

Street Maintenance in Richmond

By J. W. Eubank*

Organization of the Department and work done in repairing gravel, concrete, spall, asphalt block and asphalt concrete surfaces on 204 miles of paved and gravelled streets

The Street Maintenance Bureau of Richmond, Virginia, is one of two bureaus of the Department of Maintenance and Street Cleaning and is in charge of a superintendent who supervises the maintenance of all streets, sidewalks and bridge surfaces to keep them in a safe and usable condition; the installation of drain pipes for removing surface water at street intersections; resurfacing, reshaping and oiling gravel road beds; building gravel roads; improving old pavements by relaying, resurfacing or replacing small portions that are worn out; treating earth and gravel roads with dust-laying materials; resetting and replacing curbs, gutters and sidewalks; building barricades, bulkheads, etc.; grading and cindering alleys, streets and sidewalks; inspection of all work done under permits granted by the Bureau pertaining to openings in the surface or construction work within the boundaries of the city highways; and reporting on all complaints made by citizens concerning street surface conditions. The area covered by this supervision is approximately 25 square miles. The superintendent is aided by an assistant, two foremen, a sub-foreman, two inspectors and a contractor. The average force of laborers is about 135.

There are in the city 376 miles of dedicated streets, of which 67 miles is smooth pavement, 47 miles is stone pavement, 90 miles is bank gravel and 152 miles earth and cinder surface.

The organization is divided into the following units: Truck and steam shovel outfit, one foreman and 14 laborers, for general hauling and maintenance and building gravel and cinder roadways;

Oiling and dragging outfit, one foreman and eight laborers, treating roads with dust-layer, dragging and scraping earth roads;

Bridge and culvert outfit, three laborers, looking after the installation of drain pipes and open drains, repairing bridges, etc.;

Grading outfit, one foreman and six laborers, looking after the grading of alleys, sidewalks and streets;

Scarifier-roller outfit, six laborers, scarifying, reshaping and rolling gravel roadways;

Emergency force, three laborers, answering emergency calls for minor repairs to sidewalks, alleys, streets, etc.;

Repairing smooth pavement, three foremen and sixty-five laborers.

All materials. equipment and tools are furnished by the Bureau, while the contractor contracts for labor, doing the work outlined by the superintendent on all improved pavements, including pavements disturbed by the various departments in making service connections.

*Chief of Bureau of Repairs, Maintenance and Cleaning, Richmond, Va.

EQUIPMENT USED FOR REPAIRING ASPHALTIC CONCRETE SURFACES.

The inspectors look after all work done under permit pertaining to the restoration of street surfaces, construction of vaults, cellar doors and sidewalks, erecting poles, gasoline pumps and banners, and reporting on bad conditions of any street surfaces.

Contracting for maintenance of improved pavement has proven to be the best method tried for handling this work. It takes less inspection, gives us the opportunity to employ better skilled workmen for paving work, does away with the many contentions that are usually caused by contractors, and fixes where it belongs, the responsibility for the maintenance of the street surfaces due to trench work. Work done under this plan is such that a trench seldom if ever settles after being repaved and the cost is 25 per cent. less than any other method heretofore used.

REPAIRING GRAVELLED ROADWAYS.

Heavy hauling and rapidly moving vehicles cause such disintegration of gravelled roads that after four months a good, smooth surface is filled with pot holes. Such surface is scarified with a steam roller having a scarifier attachment, followed by a Fordson attached to a Baker grader which pushes the loose material from each side to the center and then pulls it back again, this operation stirring up the material and distributing it evenly, also bringing the large gravel to the top where it is gleaned off and hauled away. If it is dry, the road is then thoroughly wet and any new material needed to give the surface the proper crown is supplied. The surface is then again shaped with the road machine and rolled thoroughly, after which in many cases 1-1/2 pounds per square yard of calcium chloride is applied or, if the amount of traffic warrants it, an application of asphalt oil is used.

Some of the most important instances of oiling roadways have been surface-treating the gravelled roadways around Shields Lake and William Byrd Park with a cold application of Barber asphalt oil, 1/2-gallon to the square yard, covered with 25 pounds of stone chips per square yard; surface treating Hull street and Broad Rock road with a hot and cold application of Tarvia B and A covered with pea gravel. In the latter treatment, after thoroughly cleaning the surface to be oiled, 1/2-gallon of cold B oil per square yard was applied and allowed to penetrate, when it was followed by a hot application of A oil, 35 gallons to the square yard, which was immediately covered with 45 pounds of pea gravel. Many old main thoroughfares have been re-oiled with a cold application of from 1/4 to 1/2 gallon per square yard, depending upon the quantity the surface would hold, and then covered with chips and asphalt block.

REPAIRING CONCRETE SURFACES.

Concrete gutters, walks and roadways when worn very badly are replaced with a very dry mixture of 1:2:4 concrete rammed thoroughly before trowelling; but in many cases where roadways and gutters have worn in small holes or been gouged out at the joints, these places are repaired with rock asphalt; while in some cases deep holes in the gutters are repaired with a cold patch material which is kept already mixed. The cold oils used are Tarvia K. P. and Kolmend prepared by the U. S. Asphalt Refining Company. Rock asphalt has proven to be the best patching material we have used. Any hole that is over 2 inches deep is filled with stone to within 2 inches of the surface and cold patch material used for 2 inches depth only for the sake of economy. The edges of the holes are painted with asphalt and the patching material placed and tamped and ironed out by traffic.

Expansion joints and cracks in these roads are gone over in the Spring, being cleaned out thoroughly with sharp tools and brooms and then filled with an asphalt filler of approximately 45 penetration. Better results seem to have been obtained by doing this work in the Spring than in the Fall because the dryness of the ground gives deeper and better bond to the concrete.

REPAIRS TO SPALL PAVEMENT.

A marked improvement has been obtained by relaying old stone pavement with asphalt filler on five of the streets of the city, the new surface in some cases resembling sheet pavement. This repaving not only produces a better appearance and makes the street easier to clean, but adds to the comfort of motorists, saves wear on vehicles, makes the stones more difficult to displace and saves a great deal of minor maintenance. Four blocks of the north side of Main street, originally paved with Belgian block on a concrete base, had been disturbed by sewer construction. After the base had been restored the blocks were relaid at an angle of 22½ degrees with the curb on 2 inches of dry cement-sand grout mixed 1:3 and sprinkled; the joints were

MIXER USED FOR PREPARING TOPEKA MIX.

(Continued on page 328)

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Inconsistencies in Bidding

Contractors as a class are more intelligent and contracting is on a more substantial basis and more scientifically performed than was the case a generation ago. This being so, we can but wonder at some of the bids that are submitted from time to time.

Two recent bids on sewer work will serve as illustrations. At a letting in Washington, bids were received for trench excavation and backfilling, furnishing and laying pipe being separate, and bids being received for different depths of trench. As difficulty and cost of excavation increase more rapidly than the depth, so did the price bid by most contractors; one, for example, bidding 90 cts. for 4 to 6 ft., $2.80 for 10 to 12 feet., and $10 for 16 to 18 ft., while another bid 80 cts., $2.60 and $8 for the same items. But the successful bidder's figures were 85 cts., $1.20 and $1.65 respectively—less than double the price for four times the depth, instead of seven to eleven times as in the other bids.

The other case was similar, the low bidder offering to lay 24 in. pipe in an 8 to 10-foot trench for the same price as in a 4 to 6-foot one, although the other bidders increased their figures by an average of 38% for the greater depth, or $1.23 per lineal foot.

In each of these cases the items referred to were the chief ones of the contract and there was no unbalanced bidding evident in the figures submitted, except as those given above might be so considered.

Fortunately, the large majority of contractors bid with much greater consistency and intelligence, or engineers would soon give up as useless the dividing of work into units of reasonably uniform cost as an aid to contractors in making business-like bids rather than guesses or gambles.

Garbage Reduction Expensive

The city of Chicago has for several years been disposing of its garbage by reduction at a city-owned and operated plant, part of the garbage being hauled directly to the plant and part by boat from loading stations. Last year extensive improvements and extensions of the plant were completed. We have not the figure for the total cost of these, but the amount paid out on these improvements last year was more than $79,000. These improvements were completed so that the improved plant was in full operation by June. Taking the operating costs and revenues for the last seven months of the year, we find that 71,368 tons of garbage were treated, at an average cost, including the operating expenses only, of $5.93 a ton. The revenue from all sources averaged $1.79 a ton, giving a net cost, operating expenses only, of $4.14. We have not readily at hand the total cost of the plant, but interest and depreciation on that would probably amount to as much more. In addition to these costs, we have the cost of collection of $5.57 per ton, giving the total expenditure for the seven months of $11.50 a ton.

It is pointed out in the report that, presumably because of the improvements made, the cost of operating the plant was less than during the previous year, although the amount of garbage re-

ceived was greater, the net operating cost per ton of garbage in 1921 having been $6.04.

With this financial condition of affairs known, the question naturally suggests itself why the plant was not abandoned entirely instead of spending over $79,000 on improvements.

Chicago is so located that it is practically impossible to dispose of the garbage by dumping and, considering the enormous amount of garbage involved, it might be questioned whether hog-feeding at a sufficient distance from the city to provide against nuisance would be practicable. There does not seem much question, however, that destruction of the garbage in incinerators or destructors could be secured at a considerably less operating cost than $4.14 a ton—in fact, the cost might well be so much less than this that the saving would pay for the new incinerators in a very short time. Incineration would also probably make possible an additional saving in that a number of incinerators could be scattered throughout or around the outskirts of the city so as to reduce considerably the average haul and thus effect a considerable reduction in the collection cost, which totalled nearly $600,000 last year, $94,000 of which was the cost of operating the loading stations and transporting the garbage by boat.

The actual expenditures for collection and reduction of garbage last year exceeded $1,350,000, or, deducting the revenue, the net cost exceeded $1,213,000. This sum certainly is large enough to offer an inducement for a serious consideration of the question with a view to adopting some much more economical method whereby a saving could probably be made of at least $500,000 a year. It is certainly to be hoped, for the sake of the taxpayers, that something of this kind will be done rather than continuing to invest the city's funds in extensions of what shows no hope of being anything but a losing proposition.

Chicago is but an extreme illustration of what all reduction plants have been experiencing during the past two or three years. We believe all, without exception, have operated at a loss, and there seems to be no hope for improvement unless the demand for garbage grease and tankage increases very materially, with a resulting rise in prices paid for them.

Contractor Profits by Winter Work

In the Fall of 1922 the commissioner of state highways of Minnesota advertised for bids on a number of projects to be carried on during the Winter, although this state is far within the region of heavy snows. Among these was a 15-mile stretch of gravelling which was let to the Connelly Contracting Company of St. Paul. The engineer's estimate on this work was $83,000, but the successful contractor's bid was $49,900, and the contractors put through the contract and presumably made money by superior organization.

The contractors had already reinforced their truck frames with heavy steel I-beams. As the state specifications required that the gravel be hauled in loads that were level with the top of the truck bodies, the contractors built up their truck bodies one-third more than the original height in order to haul as large loads as practicable, the hauling being paid for by the yard-mile, 17c for the first mile and 4c for each additional mile. The average length of haul was 12 miles.

Another item of preparedness was the fixing of the road over which the hauling had to be done during the Fall, shapers, graders and tractors being used so that when freezing weather arrived the 15-mile stretch was smooth and hard and traversed as easily by the trucks as though paved. The contractors also leased a farmhouse, a hotel, restaurant and garage for insuring the proper living conditions of their employees and the keeping of their trucks, tractors, graders, steam shovels, etc., in proper condition by expert mechanics who were continually on the job. As they used $5,000 worth of gasoline a month, the Standard Oil Company installed a 1,000-gallon filling station at the farmhouse, which was located near the gravel pit.

The men were worked in two 8-hour shifts and thus the expensive trucks and other equipment were kept operating 16 hours out of the 24. By keeping men and equipment co-ordinated and working to advantage, 22,400 yards of gravel were hauled and spread during the severe Winter conditions at the remarkably low cost indicated.

Street Cleaning Statistics

Figures and other information from about two hundred cities concerning the expenditure for street cleaning, cleaning of sidewalks, snow removal, use of hand brooms, machine brooms, pick-up sweepers, flushing machines, flushing by hose, and other details

From questionnaires returned to this office during the past month we have compiled exceedingly interesting and valuable information concerning the methods and appliances used for street cleaning and the disposal of street cleanings and garbage in about two hundred cities in all parts of the country. The tabulation of disposal data is not included this month because of limitations of space, but will be given in the November issue, together with a summary and analysis of much of the tabulated information.

STREET CLEANING STATISTICS—I.

City	Expenditure Last Year	Notes on Expenditure
Alabama:		
Florence	No record	Done by garbage department.
Gadsden	$3,239.11	.....
Talladega	About $7 per day	One man and two 1-horse wagons daily. 3 extra teams after rains.
Arizona:		
Tucson	$5,543.00	$130 for brooms; balance wages at $2.50 per day.
Arkansas:		
Fayetteville	2,500.00	Hand sweeping, shoveling gutters, flushing with fire hose.
California:		
Monterey	4,500.00	Labor and teams.
Napa	3,200.00	Hand brooms and small cart daily in business section; whole street force Saturday in residence section with hand brooms.
Redlands	5,992.00	.....
Santa Ana	37,526.00	$11,162 for street sweeping, $4,305 disposal of sweepings, $4,805 disposal of street trash; $17,254 disposal of garbage, paper and cans.
So. Pasadena	5,000.00	.....
Colorado:		
Denver	225,000.00	Sweeping paved streets and alleys, flushing paved streets, cutting and burning weeds, cleaning dirt alleys once a year.
Connecticut:		
Hartford	213,821	Cleaning improved pavement, $160,756; macadam, $53,066; includes snow removal.
New Britain	13,974.00	10 patrolmen on pavements, 5 men and teams 5 summer months on macadam; extra gang on leaves in October.
New Haven	110,000.00	Includes care of public dumps, removing refuse from police stations and other public buildings, and snow removal.
New London	18,000.00	$8,000 for sweeping, $10,000 for snow removal.
Willimantic	8,000.00	.....
Florida:		
Key West	6,000.00	.....
St. Petersburg	4,078.00	$2,440 for horse-drawn sweeper, $1,638 for teams.
Georgia:		
La Grange	9,000.00	Appropriation for 1923, includes cleaning and maintaining storm sewers.
Idaho:		
Lewiston	$16,000.00	White-wings, street washing and garbage collection.
Twin Falls	5,000.00	Absence of storm sewers & surrounding desert increases cost.
Illinois:		
Canton	3,000.00	.....
Freeport	5,000.00	.....
Kankakee	30,328.00	Also $22,937 for alley cleaning and garbage collection and $4,565 for care of parks.
Oak Park	19,660.00	Sweeping, $8,611; hauling, $9,246; miscellaneous, $1803.
Quincy	6,700.00	Estimated, entire paved area, Main St. by white wings.
Sterling	10,952.00	Includes removing ashes and cans and repairing streets.
Indiana:		
Bedford	14,000.00	6 miles of brick streets, 79 miles mostly gravel and macadam.
Brazil	1,500.00	Including sweeping, flushing and collecting leaves on paved sts.
Elkhart	18,000.00	Total expenditure of Street Department.
Gary	34,000.00	Does not include superintendent of streets.
Hartford City	1,200.00	.....
Indianapolis	150,000.00	Average cost of cleaning, $390 per mile.
Lafayette	12,984.00	Street sweeping, $7,995; gutter cleaning, $4,989.
La Porte	12,000.00	10 white wings at $3.50 per day.
Lebanon	3,500.00	.....
Shelbyville	7,000.00	About $2,500 for cleaning 2½ miles of business section with horse-drawn sweeper. Other 28 mi. of street swept occasionally.
South Bend	40,000.00	Accounts of Street Department not segregated.
Terre Haute	39,000.00	.....
Wabash	5,200.00	Labor, $5,100; equipment, $100.
Iowa:		
Cedar Rapids	18,112.00	One flusher with pick-up gang and 12 white wings.
Charles City	2,913.00	Three white wings at $65 per month in business district, horse drawn broom once a week.
Des Moines	78,170.00	Hand sweeping, flushing and snow removal.
Keokuk	2,080.00	Contract for cleaning, flushing and sprinkling, 26 weeks at $80.
Ottumwa	5,703.00	Broom cleaning, $4,681; flushing, $1,022. 30% in residence district.
Kansas:		
Iola	4,123.00	.....
Pratt	1,500.00	.....
Kentucky:		
Ft. Thomas	.....	Little cleaning done; included in street maintenance cost.
Louisville	243,672.00	.....
Mayfield	2,628.00	Does not include extra expense after celebrations, shows, etc.
Maine:		
Bangor	12,662.00	.....
Rockland	3,619.00	Teams used for fire also so charged to Fire Department and men charged to street cleaning.
Massachusetts:		
Adams	6,000.00	.....
Brockton	29,411.00	Cleaning gutters, $4,926; watering, $1,204; cleaning basins, $5,363; removing snow, $5,962; flushers, $465; scraping, $2,594; sweeping, $8,998.
Cambridge	80,850.00	Labor, $70,039; tools, $196; use of horses, $10,614.
Concord	4,361.84	.....
Gardner	8,000.00	.....
Haverhill	24,000.00	1 Elgin sweeper and hokey pokey men included.
Hudson	8,000.00	Includes snow removal and 1 white wing.
Natick	3,000.00	Includes cleaning basins; one man with push cart in centre of city all the time, 10 men and 2 or 3 teams one-half day a week.
Northbridge	2,300.00	.....
Orange	.....	$15 a week for man with 2-wheel cart, keeps clean the square and ¼ mile from it out each street.
Reading	600.00	Police work in main square; only hand-broomed and shoveled into Ford dump twice a week by 2 men
Michigan:		
Alma	1,744.64	Rubbish removal (cans, ashes, etc.) cost $1,877.04; flushing (driver, repairs, oil, gas, harness, shoeing, etc.), 1,745
Ann Arbor	21½c. per 1,000 sq. yd.	1 Elgin pickup sweeper.
Flint	32,908.54	$2,188.67 for snow removal. Balance on paved street cleaning.
Highland Park	24,857.00	Snow cleaning and all street cleaning.
Holland	8,000.00	Includes street flusher and four sweepers.
Manistique	900.00	1 white wing.
Muskegon	20,000.00	.....
Pontiac	16,000.00	.....
Minnesota:		
Cloquet	2,580.10	Cleaning streets.
	3,119.40	Removing snow.
Rochester	5,238.71	Flushing cost.
	5,750.76	Pickup men, 2-yd. dump wagons, 1¼ miles average haul.
St. Paul	250,000.00	Includes $30,000 sewer cleaning, $10,000 dump maintenance.
Missouri:		
Jefferson City	500.00	.....
Kansas City	337,528.51	Hand-brooming, push carts and dump carts.
Marshall	.....	1 man and cart—gutters cleaned 2 or 3 times a year.
St. Joseph	5,000.00	Sweeping and flushing.
Sedalia	3,300.00	By contract.
Montana:		
Bozeman	1,900.00	$675 for hand cleaning Main St.; $1,225 from various cleaning and flushing districts, 75% of which is charged against abutting property.
Lewistown	4,000.00	Flushing and hauling off twice a week.
Livingston	5,000.00	Two men continuously with Fordson tractor, scraper and wagon.
Nebraska:		
Lincoln	23,291.67	White wings, $7,490.48; outside cleaning, $13,953.13.
Norfolk	5,500.00	.....
New Hampshire:		
Nashua	12,784.28	.....
New Jersey:		
Asbury Park	30,000.00	.....
Irvington	5,000.00	.....
Salem	3,000.00	.....
New Mexico:		
Albuquerque	12,000.00	White wings.
New York:		
Endicott	3,454.00	Hand brooms and scrapers on pavement, $1,616; hauling snow, $490; cleaning crosswalks, $354; plowing snow, $150; flushing and sprinkling, $844.
Gloversville	6,000.	.....
Johnson City	3,000.00	Cart pickup men, $1,500; balance flushing and truck.
Norwich	1,985.50	.....
Tonawanda	2,100.00	.....

STREET CLEANING STATISTICS—I.

City	Expenditure Last Year	Notes on Expenditure
North Carolina:		
Burlington ...	8,000.00	Elgin street sweeper.
Gastonia	7,802.25	Street cleaning labor, $6,331.25; supplies, $1,471.
Thomasville ..	1,000.00	Horse-drawn sweepers two nights per week.
North Dakota:		
Fargo	36,652.00	Maintenance, salaries, tools, small equipment.
Ohio:		
Akron	121,582.00	.....
Chillicothe ...	8,000.00	Cleaning and flushing.
Cincinnati	337,290.00	Street cleaning, $131,576; snow removal, $3,397; ash and rubbish, $172,860; sewer and basin cleaning, $29,457.
Circleville	1,000.00	.....
Dayton	39,249.25	White wings in business district, hand brooms on remainder and piled for truck hauling.
Delaware	2,500.00	Flushing, hand-sweeping and hauling.
E. Youngstown	20,000.00	7 miles streets hand cleaned.
Findlay	5,000.00	Salaries and equipment.
Fremont	1,200.00	.....
Lima	26,000.00	.....
Mansfield	12,374.22	.....
Middletown ..	8,205.70	Also $78 for equipment and approx. $1,200 for horse-feed.
Urbana	7,000.00	2 men, 52 weeks @ $24 and $25 each; approx. 5 miles paved streets flushed every 3 days at cost, $600 per month.
Zanesville	13,000.00	Supt. salary, $1,500; laborers, $7,500; equipment and supplies, $4,000.
Oklahoma:		
Blackwell	25.00	Hand swept and hauled by truck.
Chickasha	6,700.00	Flushing and trucking, white wings and carts.
Enid	4,000.00	Salaries, $3,240; horse feed, $550; repairs to cart, etc., $160.
Oregon:		
Astoria	30,000.00	Includes maintenance as well as cleaning.
The Dalles....	2,180.00	$1,680 for 2 street cleaners on business streets; $500 for sprinkling once a week.
Pennsylvania:		
Ashland	Approx. 4,000.00	.....
Butler	Approx. 1,500.00	Elgin sweeper and white wings.
Clairton	3,150.00	3 miles streets cleaned regularly, 25 miles when needed.
Clearfield	Approx. 1,500.00	.....
Dormont	1,500.00	.....
Forest City...	1,700.00	Excessive owing to flood.
Freeland	1,400.00	Paved streets, $960; unpaved, $440.
Lancaster	14,000.00	.....
Meadville	5,462.59	Operation of motor sweeper, 3 white wings and extra labor.
Munhall	3,000.00	2 men, brooms, push buggy.
Norristown ..	Approx. 600.00	Hand sweeping center business streets once a week.
Philadelphia	4,551,599.00	$2,311,045 for street cleaning; $1,514,494 for ashes and rubbish; garbage, $686,594; $39,466 net loss reduction plant.
Rankin	4,000.00	.....
Ridgeway	500.00	.....
Steelton	4,119.00	Sweeping, $2,923; general cleaning, $1,196; garbage collection, $7,591.
Swoyerville ..	1,500.00	.....
Woodlawn ...	2,664.00	8 sweepers every day, also flushing machine.
Rhode Island:		
Pawtucket ...	59,097.00	Sweeping pavements, $31,934; cleaning paved gutters (mostly waterbound macadam), $18,415; snow and ice removal, $8,748.
South Carolina:		
Chester	2,500.00	Man with flusher, 300 days @ $2.25—$675; 2 men with brooms and carts, 300 days, each, @ $1.25—$750; teams, brooms, etc., approximately, $1,075.
Orangeburg ..	3,200.00	.....
South Dakota:		
Lead	575.00	Hose flushing & hand sweeping.
Rapid City....	1,480.00	.....
Tennessee:		
Jackson	5,200.00	.....
Kingsport ...	3,380.00	Hand scraper blade 5 ft. long. Cost includes garbage collection. Ford truck used to remove refuse.
Murfreesboro .	5,000.00	.....
Texas:		
Amarillo	6,000.00	Does not include alley cleaning and trash and garbage removal.
Burkburnett ..	2,000.00	Sanitary officers' salaries etc. Business sections cleaned by merchants.
Texas (Continued)		
Childress	900.00	.....
Del Rio.....	1,200.00	.....
Eastland	2,000.00	Hand sweeping $1500; wagons cleaning gutters $500.
San Angelo...	2,100.00	Operating one horse-drawn machine broom.
Vermont:		
Brattleboro ..	2,000.00	2 men @ $15 a week. Team and extra man clean up main streets, approximately 25 miles.
Rutland	2,520.00	.....
Virginia:		
Danville	12,086.89	27,331,423 sq. yd. streets swept.
Fredericksburg	4,200.00	.....
Harrisburg ..	5,000.00	Cleaning streets and hauling garbage to dump.
Newport News	10,000.00	Patrols, $560; horse-drawn sweeping, $4,000; equipment, repairs and replacements, $600; labor, $4,840; Elgin pickup machine installed June, 1923, $6,500.
Richmond ..	85,431.53	Street cleaning cost.
Staunton	3,000.00	.....
Washington:		
Aberdeen	5,017.25	Labor, $4,390; water, $550; supplies, $57; equipment maintenance, $20.
Walla Walla..	9,200.00	Flusher driver, $2,500; pick-up laborers, $5,000; repairs to equipment, $700; flushing water, $1,000.
West Virginia:		
Clarksburg ...	9,034.97	.....
Fairmont	4,000.00	3 or 4 men with flushing machine and truck, principally in business section. Push brooms in gutters.
Wisconsin:		
Beaver	3,500.00	Part of the work done by fire teams.
Kaukauna ...	2,089.74	Snow and ice removal, $1,083; street sprinkling (water and oil), $3,034.
Kenosha	58,230.00	.....
Marinette ...	10,000.00	Cleaning and repairs included.
Wisconsin Rapids	2,400.00	Cost approximates, 22c. per 1,000 sq. yd.

(*Continued from page* 324)

then filled with hot gravel almost to the surface, following which a hot mix of two parts sand and three parts asphalt was poured in until the joints were full and then broomed over and covered with stone chips. At other locations the rough stones were relaid on the original sand cushion, the joints filled with gravel and asphalt as above and covered with stone chips and sand grits. About two gallons of asphalt were used to the square yard. The total cost of the work was about 75c per square yard.

REPAIRS TO ASPHALT BLOCK PAVEMENT.

Where cuts occur in asphalt block pavement, the pavement has been relaid with an asphalt filler that leaves a mat on the block, protecting from water and wear and giving the appearance of sheet pavement. In no case has this pavement settled over a trench after relaying. Some old asphalt block pavement was relaid with asphalt joint filler, which gave very good results and is a very simple and economical method of preserving this class of pavement. The cost of this work was 75c per square yard.

REPAIRS TO ASPHALTIC CONCRETE SURFACE.

It has been a somewhat perplexing problem to decide just what was the most practical method of repairing our asphalt concrete surfaces, which in many cases were irregular and worn due to burnt materials, while in other cases, especially on some of the main boulevards, high ridges and puffed up places had occurred because the base was slick and the mixture too fat. Moreover, we are constantly cutting into these surfaces for renewal of service pipes, etc. Replacement of

pavement over these cuts is done by this Bureau, which keeps an accurate account of the cost of the work and issues monthly statements to the various city departments or bureaus and companies or corporations.

This Spring there were approximately 6,000 square yards of the various types of sheet asphalt pavement to be repaired, and we decided to try on this work the Iroquois rapid mixer. This plant is mounted on a steel truck frame and can be hauled easily from point to point by a team or tractor or, better still, by the roller used on the work. This mixer is operated on the work without inconvenience to traffic.

The batches used by us were 500 pounds, consisting approximately of Topeka mix as follows: 135 pounds of stone, 200 pounds of coarse sand, 100 pounds of fine sand, 25 pounds of limestone dust and 40 pounds of Genasco liquid asphalt. The mineral aggregate was measured in boxes and struck off and put into the hopper, which is hoisted mechanically into the drum. The engine is then thrown into gear and asphalt is poured in while the paddles are revolving; immediately after which two pints of gasoline is thrown into the drum and ignited with a piece of burning waste attached to the end of a long stick. In about five or six minutes the gas and volatile matter in the asphalt is consumed and you get a batch of material that is thoroughly mixed and has a temperature of between 285 and 300 degrees F. There is absolutely no danger of burning the batch. The aggregate must be thoroughly dry, and our method is to heat the fine sand at the storage pile as it is hauled from the cars and store it under a shed, hauling it to the mixer as needed; this proving to be more economical than heating on the job.

Almost any kind of labor can be used to operate the mixer. Our gang consists of one roller man who acts as foreman, two men at the mixer, two men hauling materials to and from the mixer (concrete buggies are used for this purpose), one raker, and five men cutting out bad asphalt and painting edges of holes prior to putting in hot stuff.

Our average cost for patching this year to date is $1.16 per square yard, this including materials and all labor and truckage on operations. The sheet laid has varied from 1-1/2 to 2 inches thick and the work has been scattered over all sections of the city. The cost of materials and truckage was 80c a square yard and labor 45c a square yard, although on good days the cost of labor for mixing material has been as low as 21c per square yard, this not including the cost of cutting out old work. This plant has more than paid for itself in forty days of continuous use as compared to the old method of reheating old material and replacing it, while at its best the old material could not be relied upon. An 8-ton tandem roller has been used for rolling patches and they can hardly be discerned except that after heavy rains they show a little darker than the original pavement.

WORK DONE LAST YEAR.

During 1922 we oiled 12.6 miles of streets with an average width of 22.2 feet, at a cost of $1,429.42 per mile; scarified and reshaped and rolled 48.31 miles of gravel roads averaging 22.05 feet wide at a cost of $247.28 per mile; surfaced with gravel and built 14.09 miles of road averaging 20.1 feet wide at a cost of $1,350.46 per mile, or $1.03 per cubic yard in place. Approximately 6 miles of earth streets were improved with a layer of material from the Tredegar Iron Works to a depth of about 8 inches. This proved to be excellent material for unimproved roads, as it contains a large percentage of iron ore and when compacted will carry the heaviest class of traffic and does not dust up like cinders. In addition, 4.33 miles of earth roads were scarified, reshaped and rolled for an average width of 23.67 feet at a cost of $137.18 per mile. Ninety-two miles of roadways were shaped with a road machine at an average cost of $36.25 per mile; 5.55 miles of gravel roadways were treated with calcium chloride for an average width of 20.52 feet at a cost of $241.87 per mile. The calcium chloride treatment is very satisfactory, especially in dry weather, as it keeps down the dust by collecting moisture from the air and holds the material intact.

Device Used for Painting Center Line on Highway

The California Highway Commission, like those of several states, has this year adopted the practice of painting a line down the center of the highway as a device for furthering the safety of travel thereon by confining automobiles to their own side of the roadway. The illustration shows a white line being painted down the center of the highway south of San Francisco. In this work a simple device is used consisting of a paint receptacle carried on a three-wheel hand-truck from which a hose leads to a paint brush attached to the front of the device just back of the front wheel. This brush applies the paint to the surface of the highway, and a second brush a few inches back of it spreads the paint to the proper width. A red chalk line is marked on the pavement ahead of the paint spreader to guide the path of the latter. A truck follows carrying wooden standards which are placed over the painted line about 15 feet apart to protect the paint from vehicles while it is fresh.

MARKING CENTER LINE OF CALIFORNIA ROAD.

STREET CLEANING STATISTICS—II

City	What percentage of sidewalks does city clean?	Snow Removed by City: From how many miles of streets?	Snow Removed by City: Methods and appliances used	Area of Streets on Which City Uses: Hand Brooms	Area of Streets on Which City Uses: Machine Brooms
Alabama:					
Florence	None	30	Shovels	Business district	None
Gadsden	25	None	.....	Gutters only	None
Talladega	None	.....	.....	2 or 3 mi.—scrapers	None
Arizona:					
Tucson	None	.....	.....	All pavements	None
Arkansas:					
Fayetteville	None	None	.....	35,000 sq. yd.	.....
California:					
Monterey	None	None	.....	Whole city	None
Napa	None	.....	.....	21,000 sq. yd. per day	None
Redlands	None	None	.....	30 miles gutters	.....
Santa Ana	None	None	.....	Entire paved area	Entire paved area
South Pasadena	None	.....	.....	40 miles	None
Colorado:					
Denver	None	25 miles	Trucks, teams, caterpillars and blades	150 downtown blocks	72 mi. paved sts.
Connecticut:					
Hartford	Park walks only	12 miles[b]	Teams, laborers, snowplows, caterpillar steam shovels, motor trucks	1,839,308 sq. yd.[c]	None
New Britain	None	Plow 50 miles remove 3 miles	Truck plows; hand shoveling to teams, trucks and trolley cars	.....	None
New Haven	Public bldgs. only	20 miles	Plows, steam shovels, trucks and trolley plows	All	None
New London	Public prop. only	3 miles	Hand shovel into trucks and carts	72,000 sq. yd.	None
Willimantic	None	25 miles	Motor plows and carts	5 miles	None
Florida:					
Key West	None	None	.....	All paved streets	None
St. Petersburg	None	.....	.....	20 blocks	None
Georgia:					
La Grange	None	.....	.....	6 miles gutters	None
Idaho:					
Lewiston	Business district	30 mi. sidewalks	Horse plow	3 miles	None
Twin Falls	All residence sts.	½ mile	Wagons	Corners and crossing gutters	None
Illinois:					
Canton	40	5 miles	Graders	15,000 sq. yd.	10 miles
Centralia	None	Little snow	.....	None	None
Freeport	None	None	.....	All	None
Kankakee	Snow only—all	Paved streets	Horse-drawn snow plows	12 miles	.....
Oak Park	Snow only—all	None	Horse plows	Gutters only	None
Quincy	2 miles	6 miles	Graders, teams and wagons	5 miles daily	None
Sterling	None	Going to in business district	.....	.....	.....
Winnetka	Snow only—all	None	Horse plows	Yes	8 blocks bus. dist.
Indiana:					
Bedford	None	Street crossings	Hand shovels	6 miles	None
Brazil	None	2 miles	Shovels and wagons	Gutters of all streets	Main streets
Elkhart	Snow only—all	1 mile	Teams, grader and wagons	300,000 sq. yd.	300,000 sq. yd.
Gary	.....	No stated amount	Motor snow plows	20 business blocks	None
Hartford City	Snow only—all	None	Snow plows	None	Yes
Indianapolis	None	371 miles	Snow plows and large scoops, drawn by 5-ton trucks; scrape to manholes	All	Street car lines
Lafayette	None	17 miles	Hand shovels, trucks and wagons	17 miles	None
La Porte	All	None	.....	All	None
Lebanon	Snow only—all	1 mile	Dump wagons	.....	17,600 sq. yd.
Shelbyville	None	2½ miles occasionally	Hand shovels and wagons	None	25 miles
South Bend	Snow only	Business district	Grader and trucks	Business district	.....
Terre Haute	None	3 miles	Grader and shovels	3 miles[b]	None
Wabash	None	0.8 mile	Snow plows, graders, wagons	11 miles	None
Iowa:					
Cedar Rapids	5	1 mile	Trucks, wagons, shovels	4 miles	.....
Charles City	None	None	.....	36,520 sq. yd	88,273 sq. yd. (once a week)
Des Moines	None	Business district	Hand removal	All	None
Keokuk	None	None	.....	70,500 sq. yd.	None
Ottumwa	Very few	3 to 5 blocks	Trucks	.....	None
Kansas:					
Iola	Only snow	Around public sqs.	Shovels and brooms	Along curbs	All pavements
Pratt	None	None	.....	4 blocks	None
Kentucky:					
Fort Thomas	None	.....	Trucks	.....	.....
Louisville	None	2 miles	Snow plow and wagons	Gran., brick & asphalt	.....
Mayfield	None	1 mile	Hand shovels	1 mile	None
Maine:					
Bangor	50	1 mile	Teams	1½ miles	¾ mile
Rockland	None	1½ miles	Horses and sleds	33,700 sq. yd.	None
Massachusetts:					
Adams	None	3 miles	Men and teams	1 mile	4 miles
Brockton	None	3 miles	Scraper and hand shovel	2,300 sq. yd.	Scattered
Cambridge	Public property	Very few	Horses and teams	.....	All
Concord	Small	Ap. 40 miles	Holt 10-ton tractor, Sargent plow, 3 truck plows	Very small	None
Gardner	None	50 miles plowed	10-ton Holt tractor	60,000 sq. yd.	Some
Haverhill	None	10 miles	Trucks, teams and shovellers	10 miles	.....
Hudson	Snow, all	All streets	Truck plow	½ mile, 28 ft. wide	Once in 2 weeks

STREET CLEANING STATISTICS—II

City	Area of Streets on Which City Uses: Pick-up Sweepers	Flushing Machines	Hand Flushing by Hose	Day or Night Cleaning by: Machine Sweepers in Business Dist.	Flushing	Average Area Per Man Covered by White Wing or Patrol
Alabama:						
Florence	None	None	None	.....	.....	.....
Gadsden	None	202,000 sq. yds.	None	.....	Night	.....
Talladega	None	None	None	.....	.....	.....
Arizona:						
Tucson	None	None	None	.....	.....	30,000 sq. yds.
Arkansas:						
Fayetteville	.....	.....	10,000 sq. yds.	.....	Night	8,000 sq. yds.
California:						
Monterey	None	None	None	.....	.....	10,000 sq. ft.
Napa	None	50,000 sq. yd.	None	.....	Day	21,000 sq. yd.
Redlands	3 miles	2 miles	.....	.....	Night	2 miles
Santa Ana	.....	None	.....	Night	.....	18,000 sq. yd.
South Pasadena	None	None	None	.....	.....	1 mile
Colorado:						
Denver	72 mi. paved sts.	All paved streets	None	Night	Both	About 10 blocks
Connecticut:						
Hartford	None	563,194 sq. yd	None	None	Night	10,000 sq. yd.
New Britain	None	Being tried on pav.	None	.....	.....	5,000 to 30,000[a]
New Haven	None	60 miles	None	.....	Day	20,000 yds.
New London	None	None	None	.....	.....	72,000 sq. yds.
Willimantic	None	None	2 miles	.....	Night	2 miles
Florida:						
Key West	None	None	Paved streets when necessary	None	None	None
St. Petersburg	None	None	None	.....	.....	5 blocks
Georgia:						
La Grange	None	150,000 sq. yd.	None	.....	Night	.....
Idaho:						
Lewiston	3 miles	3½ miles	None	.....	Night	1 mile
Twin Falls	None	17 mi.—all pav.	.....	.....	Busi., night; residence, day	14 blocks
Illinois:						
Canton	None	None	None	Night	.....	15,000 sq. yd.
Centralia	All	None	None	Night	.....	.....
Freeport	None	None	Business dist.	.....	Night	3 men
Kankakee	15 miles	.....	.....	Early morning	.....	12 blocks
Oak Park	None	None	None	.....	.....	None
Quincy	None	5 miles	None	No	Day	5 miles
Sterling	.....	.....	.....	.....	.....	.....
Winnetka	Business district	None	None	.....	.....	.....
Indiana:						
Bedford	None	None	10 blocks	.....	Night	10 blocks
Brazil	.....	.....	1 mile	Night	Night	.....
Elkhart	None	None	None	Night	.....	None
Gary	.....	.....	None	.....	.....	20 blocks
Hartford City	None	None	None	Night	.....	None
Indianapolis	None	All	Downtown car line intersections	.....	Two 9-hour shifts	22½ squares
Lafayette	None	None	None	.....	.....	1 mile
La Porte	None	None	None	.....	.....	15,000 sq. yd.
Lebanon	None	None	None	Early morning	.....	7,000 sq. yd.
Shelbyville	None	None	None	Night	.....	.....
South Bend	Balance of paved streets	All	None	Night	Night	5 to 10 blocks
Terre Haute	None	None	None	.....	.....	¾ mile
Wabash	None	None	Business dist.—3 times summer	.....	.....	2 miles
Iowa:						
Cedar Rapids	.....	71 miles	.....	.....	Both	9,000 sq. yd.
Charles City	None	None	None	.....	.....	12,170 sq. yd.
Des Moines	None	Business district	None	.....	Both	.....
Keokuk	None	70,500 sq. yd.	None	.....	Night	23,500 sq. yd.
Ottumwa	None	Busi. dist. mostly	None	.....	Day	6 to 7 blks. gutters
Kansas:						
Iola	None	.....	.....	Day	.....	18 or 20 blocks
Pratt	None	None	None	.....	.....	.....
Kentucky:						
Fort Thomas	.....	.....	.....	.....	.....	.....
Louisville	.....	All granite, brick and asphalt	None	Night	Night	2 miles
Mayfield	None	.....	Occasionally	.....	Night	mile brick street
Maine:						
Bangor	None	1 mile	None	Night	.....	.....
Rockland	None	None	None	No	No	11,230 sq. yd.
Massachusetts:						
Adams	.....	1 mile	.....	Early morning	Night	½ mile
Brockton	None	32,000 sq. yd.	None	.....	Night	2,000 sq. yd.
Cambridge	All	None	None	Night	.....	½ mile
Concord	None	None	None	None	None	None
Gardner	.....	None	Some	.....	.....	15,000 sq. yd.
Haverhill	10 miles	Sprinkling only	.....	Night	.....	115,000 sq. ft.
Hudson	.....	None	Sometimes	Day	.....	None

Sewer Construction Devices in Worcester

In reply to a question concerning the use of labor-saving appliances in Worcester, David M. Earle, the city engineer, informs us that an Erie steam shovel is used in excavating sewer trenches and that a fair day's work of eight hours is the excavation of about 175 cubic yards. The crew consists of an engineer, a fireman and two helpers, and the total cost of operation is figured to be about $43 for eight hours' work, giving a little less than 25c a cubic yard for the cost of excavation.

STREET CLEANING STATISTICS—II

City	What percentage of sidewalks does city clean?	Snow Removed by City: From how many miles of streets?	Snow Removed by City: Methods and appliances used	Area of Streets on Which City Uses: Hand Brooms	Area of Streets on Which City Uses: Machine Brooms
Massachusetts—(Continued):					
Natick	None	2 miles	2 or 3 teams, 1 Fordson, 2 trucks, a V plow	Gutters and pick-up, 50,000 sq. yd.	.....
Northbridge	90	2 miles	Tractor, snow plow trucks	2 miles	.....
Orange	None	Principal streets	Tractor, snow plow, auto truck	Small part	None
Reading	None	54 miles	Road and tractor plows on trucks	Gutters only	None
Michigan:					
Alma	Residence	7 miles	Graders, trucks, wagons	None	.....
Ann Arbor	All after snow storm	2 or 3 miles	Wehr grader and trucks	20 miles	.....
Flint	All	3 miles	Snow plow on tractor and trucks	90 miles	.....
Grand Rapids	None	6.3 miles	Graders, teams & trucks	3,007,555 sq. yd.	None
Highland Park	All	42 miles	Scraper and hand shovel	5 miles	42 miles
Holland	None	1 mile	Teams and sleighs	Gutters only	.....
Manistique	All, snow only	None	Horse-drawn snow plow	1 mile	.....
Muskegon	None	8 miles	Trucks and shovels	50 miles	None
Pontiac	All, snow only	4 miles	Truck and plow, tractors, hand shovel	All gutters	None
Port Huron	City property	1 mile	Shovels, wagons	250,000 sq. ft.	None
Minnesota:					
Chisholm	All	23 miles	2 trucks with plows, 2 horse plows	Gutters	None
Cloquet	All	None	.....	On pavements	None
Hibbing	All	.....	Trucks and teams	7 miles	.....
Rochester	All, snow only	.....	Home made and Baker	None	None
St. Paul	Snow from some	Downtown and main streets	Plows with Mack truck, horse drawn plows and dump wagons	90 miles	None
Willmar	None	None	.....	Paving only	Paving only
Missouri:					
Jefferson City	None	None	.....	20,000 sq. yd.	7,500 sq. yd.
Kansas City	None	603 miles	Shovel, auto carts, also flush with hose	All	None
Marshall	None	35	None	8 blocks	None
St. Charles	None	Only crosswalks	Shovels	2 miles	None
St. Joseph	None	3 miles	Trucks and wagons	3 miles	None
Sedalia	None	None	.....	None	40 blocks
Montana:					
Bozeman	1[g]	Occasionally ¼ mi.	Team, grader and sled	225,000 sq. ft.	None
Lewistown	None	None	.....	None	None
Livingston	All of snow	None	Fordson tractor and snow plow	Along gutters	None
Nebraska:					
Lincoln	None	25 miles	Grader and buckboards	.....	None
Norfolk	25	5 to 6 miles	Blade grader, wagons, shovels	30,000 sq. yd.	300,000 yd.
New Hampshire:					
Nashua	All, snow only	5 miles	Men and trucks, tractor and plow	40 miles dirt streets	None
New Jersey:					
Asbury Park	100	1 mile	Shovels and carts	3 miles	None
Irvington	None	30 miles	Trucks and plows	None	.....
Salem	None	2½ miles	Scraper	2½ miles	2½ miles
New Mexico:					
Albuquerque	None	None	.....	None	All
New York:					
Endicott	None	1 mi., plow 9 mi.	Plow on truck	Along gutters	None
Gloversville	Snow only[d]	Approx. 45 miles	Tractor and trucks with plows	None	None
Johnson City	10[d]	1 mile	Truck, shovels	3 miles	.....
Kingston	None	40 or 50 miles	Tractor with plow, shovels and carts	50% of sts. cleaned	None
Norwich	1%	½ mile	Scraper and horse-drawn vehicles	1 mile	6 to 7 miles
Tonawanda	20	None	.....	½ miles	11 miles
North Carolina:					
Burlington	None	5 miles	Shovel and snow plow	Corners and intersections	.....
Gastonia	All	17 miles	Tractor, plow, shovel, horse drag	.....	All
Thomasville	None	None	.....	Approx. 10%	90%
North Dakota:					
Fargo	Snow only[g]	10 miles	Tractor and plow	10%	.....
Ohio:					
Akron	Small	2,693,271 sq. yd.	Plows on trucks and tractors	Gang work 25.1%, station 10.2%	43.7%
Chillicothe	None	None	.....	None	16 miles
Cincinnati	None	50 miles	Snow plows, tractors, wagons, hand labor	254,500,000 sq. yd. of cleaning done	None
Circleville	None	None	.....	5 miles	.....
Dayton	City property	Business section	Baker snow plow	720,081 great squares	None
Delaware	None	None	.....	31,680 sq. yd.[h]	None
East Youngstown	10	2 miles	.....	All	None
Findlay	Snow only	Business district	Wagons and trucks	30 blocks	None
Fremont	Crossings	Sidewalks	Plow and shovels	All	.....
Lima	None	Business crossings only	Trucks	Business district	.....
Mansfield	None	2 miles	City loads, St. Ry. hauls	290,000 sq. yd.	475,000 sq. yd.
Middletown	None	3 miles when over 8-10 inches	Street grader, trucks and wagons	6 ft. from curb	7 ft. wide
Urbana	None	¾ mile	Snow plows and wagons	Busi. section gutters	None
Van Wert	All snow and ice	2 mi. crosswalks	Shovels and snow plows	.....	None
Zanesville	None	1 mile	Teams and laborers	20,000 sq. yd.	None

STREET CLEANING STATISTICS—II

City	Area of Streets on Which City Uses: Pick-up Sweepers	Flushing Machines	Hand Flushing by Hose	Day or Night Cleaning by: Machine Sweepers in Business Dist.	Flushing	Average Per Man Covered by White Wing or Patrol
Massachusetts—(Continued):						
Natick	.....	.....	½ mile	Night	Early morning	50,000 sq. yd.
Northbridge	.....	None	.....	.....	.....	.....
Orange	None	None	None	.....	.....	None
Reading	None	None	None	.....	.....	None
Michigan:						
Alma	None	100%	None	Day	Day	None
Ann Arbor	21 miles	None	None	Night	.....	3½ miles
Flint	Just started	90 miles	.....	Night	3 a.m. to 2 p.m.	15,000 yds. gutters only
Grand Rapids	5,991,491 sq. yd.	In connection with hand brooms	None	.....	Night	16,395 sq. yd.
Highland Park	42 miles	None	None	Night	.....	10 miles
Holland	.....	All pavements	None	.....	Night	25,000-35,000 sq. yd.
Manistique	.....	.....	None	None	.....	.....
Muskegon	None	None	None	.....	.....	.....
Pontiac	None	28 miles	None	.....	Both	15,000 sq. yd.
Port Huron	None	140,000 sq. yd.	None	.....	Night	.....
Minnesota:						
Chisholm	None	101,000 sq. yd.	None	.....	Both	.....
Cloquet	None	All pavements	None	.....	Day	20,000 sq. yd.
Hibbing	.....	7 miles	.....	.....	Both	.....
Rochester	None	19.2 miles	None	.....	Both	.....
St. Paul	None	All paved streets	None	.....	Night	4 blocks
Willmar	None	None	None	Night	.....	300,000 sq. ft.
Missouri:						
Jefferson City	.....	.....	.....	Night	.....	.....
Kansas City	None	None	None	.....	.....	.....
Marshall	None	None	None	.....	.....	8 blocks
St. Charles	None	2 miles	None	.....	Both	None
St. Joseph	None	120 miles	None	.....	.....	6 blocks
Sedalia	None	None	None	Night	.....	None
Montana:						
Bozeman	None	264,000 sq. yd.	Ap. 200,000 sq. ft. occasionally	.....	Early morning	225,000 sq. ft.
Lewistown	None	144,000 sq. yd.	None	.....	Residence, day; busi., night	None
Livingston	None	None	None	.....	.....	.....
Nebraska:						
Lincoln	None	65 or 75 blocks	None	Night	Night	10 blocks
Norfolk	None	300,000 yd.	None	Night	Both	10,000 yd.
New Hampshire:						
Nashua	25 miles	None	None	Night	.....	2,500 sq. yd.
New Jersey:						
Asbury Park	None	None	None	.....	.....	⅜ mile each
Irvington	All	None	None	Night	.....	.....
Salem	None	None	None	Night	.....	1¼ miles
New Mexico:						
Albuquerque	20 miles	20 miles	None	Night	Night	.....
New York:						
Endicott	None	All	None	.....	Day	.....
Gloversville	None	All paved streets	None	.....	Both	.....
Johnson City	.....	3 miles	.....	.....	Both	½ mile
Kingston	.....	All paved streets	None	.....	Night	About 1 mile
Norwich	None	None	None	.....	.....	½ mile
Tonawanda	11 miles	.....	.....	Day	.....	½ mile
North Carolina:						
Burlington	8 miles	None	None	Night	.....	.....
Gastonia	.....	.....	Main street	Night	Night	.....
Thomasville	None	None	None	Night	.....	.....
North Dakota:						
Fargo	.....	All paved streets	Alleys	.....	Night	10 blocks
Ohio:						
Akron	Included in "Machine brooms"	21%	None	Night	Night	.....
Chillicothe	16 miles	Discontinued	None	Night	.....	.....
Cincinnati	5,363,000 sq. yd. of cleaning	205,436,000 sq. yd. of cleaning	None	Night	Night	15,000, sq. yd.
Circleville	.....	2 miles	.....	Day	Day	5 miles
Dayton	None	456,700 sq. yd.	None	None	Busi. section, night; res., day	391 great squares
Delaware	None	158,400 sq. yd.	None	.....	Day	.....
East Youngstown	None	2 miles	500 feet	.....	Day	7 miles
Findlay	None	None	None	.....	.....	5 blks. & intersec.
Fremont	.....	.....	4 blocks	.....	Night	.....
Lima	60 miles	60 miles	None	Night	Busi. district, night; res., day	3 miles
Mansfield	.....	.....	.....	.....	.....	21,000 sq. yd.
Middletown	None	None	None	Busi., from 4:30 A. M.; res., day	.....	.....
Urbana	None	5 miles	None	.....	Busi. district, night; res., day	Gutters on 5 mi. of streets weekly
Van Wert	None	None	None	.....	.....	.....
Zanesville	None	30,000 sq. yd.	None	.....	Night	.....

Tree Planting on Highways

Many advocates of planting trees on highways have presented their arguments and with few dissenting from them, but recently Alexander Muir, superintendent of the Maintenance Department of the New Jersey State Highway Commission, in a discussion of the matter pointed out that the drains used under highways, an essential to maintaining proper conditions in many localities, are necessarily laid with open joints and that these joints offer entrance to the roots of trees planted nearby. He cited one stretch of road which "blew up" where, upon investigation, it was found that the drains were packed tight with tree roots which thus entirely prevented their operation.

STREET CLEANING STATISTICS—II

City	What percentage of sidewalks does city clean?	Snow Removed by City: From how many miles of streets?	Snow Removed by City: Methods and appliances used	Area of Streets on Which City Uses: Hand Brooms	Area of Streets on Which City Uses: Machine Brooms
Oklahoma:					
Blackwell	None	3 miles	Grader and drags	All	.....
Chickasha	None	None	.....	37 blocks, 400x80	None
Enid	None	Sometimes	Shovels	40 miles	None
Oregon:					
Astoria	None	.....	.....	Gutters after flusher	None
The Dalles	None	1½ miles	Trucks or scrapers	18,000 lin. ft.	None
Pennsylvania:					
Ashland	None	None	.....	Owners sweep up, truck gathers	.....
Butler	Street intersect.	1½ miles	Hand work & rd. machine	None	All
Carbondale	10	50 miles	Hand methods	All	None
Clairton	Some occasionally	Rarely	Hand scoops	All	None
Clearfield	None	1 mile	Hand shovels & trucks	3,600 ft. x 30 ft.	None
Dormont	None	1 mile	Shovel, truck	.....	.....
Forest City	Around boro bldgs.	5 blocks	Teams and sleighs	5 blocks	None
Freeland	None	0.75 mile	Trolley cars and dump wagons	2½ mi. paved streets 51 miles	None
Lancaster	None	6 to 10 miles	Snow plows and trucks		None
Meadville	60; snow	1 mile	Hand shovel and gutter plow	2½ miles	20½ miles
Middletown	None	None	.....	Outside edges, cleared area	.....
Munhall	None	None	Hand brooms and horse-drawn broom	16 miles	1 mile
Norristown	None	Only drifts	Hand shoveling & horse drawn plows assisted by street railway plows	25,000 sq. yd.	.....
Philadelphia	Debris from 100	12 miles	Machine plows, hand load and snow loaders	9,000,000 sq. yd.	16,800,000 sq. yd.
Rankin	None	1 mile	Shovels and wagons	All paved streets	None
Steelton	None	1 mile	Men and trucks	All paved streets	None
Swoyerville	None	1 mi. street cross.	Shovels	None	None
West Pittston	Crosswalks	None	Hand shovels	4 miles	.....
Woodlawn	None	1 mile	Hand shovels & trucks	52,544 sq. yd.	None
Rhode Island					
Pawtucket	None	2 miles	Shovels, trucks, tip-carts	16.5 mi. or 2,600,000 sq. ft.	None
Woonsocket	None	Where st. car trk.	Cart or trucks	.....	.....
South Carolina					
Chester	None	None	.....	70,000 sq. yd.	None
Orangeburg	All	None	.....	26,000 sq. yd.	160,000 sq. yds.
South Dakota					
Lead	40	None	.....	50% of paved streets	None
Rapid City	None	None	.....	.....	.....
Tennessee					
Jackson	None	None	.....	150,000 sq. yd.	None
Kingsport	None	.....	.....	.....	None
Murfreesboro	None	None	.....	5,000 sq. yd.	45,000 sq. yds.
Texas					
Amarillo	None	.....	.....	All	None
Burkburnett	None	.....	.....	3 blocks	None
Childress	25	.....	.....	All	.....
Del Rio	None	.....	.....	1 mi. 30 ft. wide	None
Eastland	None	.....	.....	Business district	None
San Angelo	None	.....	.....	None	7 blocks
Vermont					
Brattleboro	Snow only, all	2,000 ft.	Teams and sleighs	2,000 ft.	None
Rutland	All	½ mile	Trucks, tractors & plows	½ mile	.....
Virginia					
Danville	City prop. only	2 miles	Hose	.....	.....
Fredericksburg	None	.....	.....	136,000 sq. yd.	20,000 sq. yds.
Harrisonburg	.....	1 mile	Trucks	150,000 sq. ft.	.....
Newport News	None	34 miles	Adams grader, wagons, carts	47,000 yds.	.....
Richmond	None	50 miles	Road machines, trucks and carts[e]	.....	1,706,794 sq. yds.
Staunton	None	½ mile	Road machine, wagons	21 blocks	21 blocks
Washington					
Aberdeen	None	.....	Shovels and hand-made wooden snow plow	15 blocks	20 blocks
Walla Walla	None	Pav. sts., 30 mi.	Baker snow plow	None	None
West Virginia					
Clarksburg	None	2 miles	Road machines & trucks	14,000 sq yd.	None
Fairmont	None	Crosswalk & gutters in bus. dist.	Truck and shovelers	With flusher only	None
Wisconsin					
Baraboo	Small[d]	None	.....	None	All
Beaver Dam	None	3 blocks	Scraper	None	None
Kaukauna	All	5 blocks	Wagons	14 blocks	.....
Kenosha	5	½ mile	Hand shovels and motor trucks	30,000 sq. yd.	None
Marinette	None	2 miles	Wagons and trucks	64,120 sq. yd.	None
Wisconsin Rapids	Snow only	5 miles	Graders and carts	None	None

[a]—Depending on traffic and kind of pavement [b]—Other streets cleaned by hand scrapers made from old saws. [c]—Hauled from two miles of streets in trucks and carts, loaded by hand and steam shovels; on 48 miles, pushed to gutter with road machines pulled by Holt and Fordson tractors. [d]—When property owners fail to do so [e]—Total area of improved pavement daily, 563,194 sq. yds. of macadam once a month. [f]—Use plows on 50 to 90 miles [g]—Charged against property. [h]—Strip about 3 ft. wide along gutters.

In addition to this, he suggested careful consideration of the fact that tree roots, if growing under the pavement, are able to lift the edge of the pavement, no matter how thick and strong, and that therefore the trees should be kept a sufficient distance away from the pavement itself.

At a general conference of asphalt producers, highway engineers and officials, the asphalt

STREET CLEANING STATISTICS—II

City	Area of Streets on Which City Uses—Pick-up Sweepers	Flushing Machines	Hand Flushing by Hose	Day or Night Cleaning by—Machine Sweepers in Business Dist.	Flushing	Average Per Man Covered by White Wing or Patrol
Oklahoma:						
Blackwell	.....	None	None	.....	.....	.....
Chickasha	None	74 blocks, 400x80	None	.....	Night	16 blocks, gutters only
Enid	None	None	Business dist.	Day	.....	.....
Oregon:						
Astoria	None	15 miles	None	.....	4 to 9 A. M.	None
The Dalles	None	30,000 lin. ft.	.....	.....	Early morning	.....
Pennsylvania:						
Ashland	.....	.....	.....	.....	.....	.....
Butler	All	None	None	Night	.....	3 miles
Carbondale	None	None	20,000 sq. yd.	.....	Day	120,000 yd.
Clairton	None	None	None regularly	.....	.....	¾ mile
Clearfield	None	None	3,600x30 ft.	.....	Day	.....
Dormont	20 mi., 24 ft. wide	None	2 mi., 24 ft. wide	Night	.....	.....
Forest City	None	5 blocks	5 blocks	.....	Night	.....
Freeland	None	None	2½ miles	.....	Day	2½ miles
Lancaster	None	51 miles	None	.....	Both	16 to 20 blocks
Meadville	20½ miles	None	2½ miles	Night and early morning	Night	2½ miles
Middletown	.....	.....	.....	Day	.....	None
Munhall	None	None	.....	Day	.....	
Norristown	Discontinued	.....	.....	Day	Day	.....
Philadelphia	500,000 sq. yd.	8,000,000 sq. yds.	260,000 sq. yd.	Both	Both	20,000 sq. yd.
Rankin	None	None	None	.....	.....	.....
Steelton	None	None	None	.....	.....	1 mile
Swoyerville	None	None	None	.....	.....	1 mile
West Pittston	.....	.....	.....	.....	.....	.....
Woodlawn	None	58,500 sq. yds.	None	.....	Night	9,750 sq. yd.; also pick up paper 100 ft. from st.
Rhode Island						
Pawtucket	None	None	None	.....	.....	3.3 mi. or 520,000 sq. ft. per wk.
Woonsocket	3 miles	None	.....	.....	.....	.....
South Carolina						
Chester	None	70,000 sq. yds.	None	.....	Day	.....
Orangeburg	None	26,000 sq. yds.	None	Early morning	Night	.....
South Dakota						
Lead	None	.....	95% of paved st.	.....	Night	9,000 sq. yds.
Rapid City	.....	.....	.....	.....	.....	10,000 sq. yds.
Tennessee						
Jackson	None	150,000 sq. yds.	None	.....	Night	Gutters on 40,000 sq. yds.
Kingsport	.....	Discontinued	.....	.....	.....	.....
Murfreesboro	None	.....	.....	Night	.....	10 to 20 blocks
Texas						
Amarillo	10 blks. square	None	Isolated cases	.....	Night	.....
Burkburnett	None	None	4 or 5 blocks	.....	Night	.....
Childress	.....	.....	All	.....	.....	½ mi. 30 ft. wide
Del Rio	None	None	None	.....	.....	
Eastland	None	None	All pavements	.....	Night	.....
San Angelo	None	None	None	Night	.....	
Vermont						
Brattleboro	None	.....	1,000 feet	.....	Night	1,000 ft.
Rutland	.....	½ mile	.....	.....	Day	.....
Virginia						
Danville	All	.....	.....	Night	.....	.....
Fredericksburg	None	None	None	Night	.....	30,000 sq. yds.
Harrisonburg	.....	.....	.....	.....	.....	.....
Newport News	215,000 sq. yd.	None	None	Night	.....	23,000 sq. yds.
Richmond	829,606 sq. yds.	829,606 sq yds.	None	Night	Both	20,320 sq. yds.
Staunton	.....	.....	.....	Night	.....	.....
Washington						
Aberdeen	None	20 mi. paved sts.	.....	Both	Both	8 blocks
Walla Walla	None	30 miles	None	.....	Night	2½ miles
West Virginia						
Clarksburg	20 miles	None	14,000 sq. yds.	Night	Both	.....
Fairmont	None	All	Special occas.	.....	Day	.....
Wisconsin						
Baraboo	.....	.....	.....	.....	.....	.....
Beaver Dam	20 blocks	20 blocks	None	Night	Night	.....
Kaukauna	.....	.....	.....	.....	.....	.....
Kenosha	709,400 sq. yds.	739,400 sq. yds.	None	Day	Day	7,500 sq yds.
Marinette	None	None	None	.....	.....	16,412 sq. yds.
Wisconsin Rapids	200,000 sq. yds.	.....	.....	Early morn.	.....	50,000 sq. yds

grades were reduced from 102 to 10, this to become effective January 1st, 1924. Certain definite penetration limits were established for paving asphalt, sheet asphalt and block filler.

Progress has been made also in standardizing roller bearings, spark plugs, tires and storage batteries for automobiles; dimensions of milk bottles; containers for and shades of paints and varnishes; woven wire fencing, and other manufactured materials.

Eliminating Waste

The Chamber of Commerce of the United States reports definite progress in the elimination of waste by standardization in several industries such as automotive accessories, clay products, paints, brick, etc. Of special interest to public works officials are agreements made relative to vitrified clay sewer pipe and asphalt.

A preliminary conference by engineers and manufacturers of clay products resulted in an effort to eliminate many needless sizes and set up dimensional standards for sewer pipe, tile drain, flue linings and wall coping. A survey is being made of the industry to obtain the necessary data and when these have been gathered and tabulated a general meeting of all interests will be called for final action.

Chlorine Production at Independence, Mo.

By A. H. Gallagher*

Use of hypochlorite and liquid chlorine abandoned at this Missouri city for chlorine production at the pumping station, at less cost and with operative advantages and superior results

Following difficulty in obtaining uniform results in treatment of water by use of hypochlorite of lime, the writer some years ago began using liquid chlorine and this seemed for a time to have solved a most serious problem. However, difficulties that all who have used such equipment will appreciate soon developed from impurities in the liquid chlorine, the accumulation of which caused the small orifices to choke. Also the destructive action of chlorine made necessary frequent dismantling and repairing of the machine, which is of such a delicate nature that we have had little success in overhauling it at our plant, while the cost of repairs and replacement of parts when returned to the manufacturer for overhauling was high.

Owing to the effect of temperature upon density, the writer questions whether mechanism could be devised to satisfactorily control dosage when using liquid chlorine, since the rapidity of discharge affects the physical characteristics of the chlorine, at times, to such an extent that refrigeration even takes place. In cold weather it is quite difficult, when high rate of dosage is required, to produce a water of required bacterial standard without producing tastes of chlorine in the water. It is my opinion that the occasional taste or odor of chlorine in water to which the public objects results more from the method of application and control of the gas than from the use of chlorine *per se*.

With our experience in handling chlorine and hypochlorite of lime, the writer was in the right frame of mind to entertain a proposition to install a chlorine producing cell in the pumping station of the Independence Waterworks Company, of which he is superintendent, as an experiment, which proposition was made by the Electrolytic Chlorine Company. Cells manufactured by this company had been operated in flour mills for several years and the only new feature was the method of introducing chlorine gas into the water. The offer was accepted and one of these cells was installed in this plant about two years ago and has operated since with very satisfactory results. The control of the dosage is accomplished by controlling the amount of chlorine gas produced, this being proportional to the number of amperes of current flowing through the brine solution, and the proper rate of dosing is determined by the direct proportion between amperes used and rate of pumping water.

In the development of such a cell the problem is to design one which produces as nearly as possible the theoretical ampere efficiency, which is dependent entirely upon the prevention of secondary reactions within the cell. In the cell installed in this plant graphite pins are used as anodes, while an iron wire screen that forms the bottom of the cell is the cathode, on which rests an asbestos paper diaphragm. The cell is filled with brine and when the current passes through this, chlorine gas is liberated and sodium passes to the cathode where it unites with water to form caustic soda. Being of higher specific gravity than the brine, most of the caustic soda remains below the diaphragm, outside the cell; some of it returns to the cell because of capillary action, but the amount so returning is very small and goes into solution with the brine, while that which does not so repass is carried out through the overflow duct. It is desirable to maintain a uniform supply of brine in the cell to replace that which is decomposed by the electric current, but the brine flow may be interrupted for a time without detriment since the brine above the zone of action keeps up the concentration. The brine is made by leeching, the water seeping through a body of salt, and it is impossible for brine to enter the cell that is not a saturated solution.

Temperature has no effect upon the operation so long as it remains above the freezing point. However, a cell starting cold has a higher resistance which requires increased voltage to produce the flow of the required amperage. There is a slight disintegration of the anode, but the action is uniform throughout the period of use and does not affect the uniform operation of the cell. Apparently the anodes will require renewal about every four years, the cost of this being about $20. During two years of manufacturing our own chlorine we have found the process convenient and producing a uniform supply, positively known, accurately regulated and reliably maintained.

The water supply is taken from the Missouri river about 1½ miles below the sewer outlets of the two Kansas City's, whose combined population is upward of 500,000, and for this reason the production of a potable water is increasingly difficult. Prior to manufacturing our own liquid chlorine, the bacteriological results obtained were erratic, but during the past two years the bacteriological count has been uniformly lower than that of plants obtaining their supply further upstream and at no time has the treated water been criticized by the State Sanitary Department on account of bacterial pollution. We believe that this improvement in result is due partially to the fact that the chlorine gas is mixed with many times its volume of air before

*Supt., Independence Waterworks Company, Independence, Mo.

it is introduced into the water. This secures a greater distribution of the chlorine in the water. Its action upon oxidizable matter when so diluted will be slower but sufficiently active to effect more complete sterilization of living organisms as a result of the greater distribution.

Figures of continuous operation for 222 days show the cost of operation to have been: For salt, $51.60; for power, $106.16; diaphragm renewals, $3.60; a total of $161.36. The total amount of chlorine produced was 3,330 pounds, making the cost 4.81c per pound. The salt consumed was equivalent to 2½ pounds per pound of chlorine produced, and the power consumed to 2 kwh., which cost 1.7c per kwh. Up to date nothing has been spent in maintenance of the cell and as a new cell could be installed at a cost of $35 or less, the cost of upkeep is merely nominal. The lessened cost of sterilizing the supply, however, we consider of secondary importance to the operative advantages and superior results obtained.

An average of sixty consecutive analyses of the water gives the following results:

Average turbidity of settled water, 45.

Gas Formers—Samples collected in town: 322 ten c.c. tubes examined; negative, 318; positive, 4; percentage reduction, 98.75.

Samples collected at pumping station: 321 ten c.c. tubes examined; negative, 312; positive, 9; percentage reduction, 97.2.

The settled unchlorinated water always showed presence of gas formers, in one-half c.c.'s.

Plate Counts: Settled water, daily average, 979 per c.c.

Samples collected at station, after chlorination: Average daily count, 56; percentage reduction, 94.28.

Samples collected in town, average daily count: 70 per c.c.; percentage reduction, 92.85.

Average daily dosage, 1.1 parts per million.

The causes of the presence of gas-forming bacteria in the finished water were satisfactorily established, and in each instance it was noted that they were not traceable to delinquencies on the part of the chlorinator.

The suggestion that chlorine gas be manufactured in the pumping station as needed, and applied to the water as produced, is apt to impress the water works management at first thought as too technical, difficult and troublesome an undertaking for the ordinary operating force to handle; but, this notion is quickly dispelled under actual operation. The production and dosage of chlorine gas by this method is in reality a very simple operation, requiring but little attention, and any one capable of operating the usual pumping station equipment of a small plant can readily install and operate the cell.

Bituminous Pavement in Pennsylvania

In an interview a few weeks ago, Paul D. Wright, secretary of highways of Pennsylvania, stated that the impression in some quarters that the state would discontinue building concrete roads was a mistaken one, but that it was the "policy of the department to construct pavements suited to the present and estimated future traffic requirements. Its specifications allow bids either on all concrete or on concrete base with asphalt top pavement. The department believes that it is unbusinesslike and unwise to construct a costly pavement where for twenty or thirty years to come traffic would be equally well served by a less costly pavement, such as a bituminous surface pavement which can be put down and maintained for very much less annual cost to the taxpayer. Most of the criticism of our policy in a recent issue of a Philadelphia newspaper is a result of the bituminous resurfacing of stone roads, an operation which gives a serviceable pavement for fifteen to twenty years for a character of traffic which does not justify a more costly pavement."

He stated that resurfacing the present macadam roads with bituminous surface is "justified by present and estimated future light traffic requirements, and will enable the state to improve more miles of roads and lift more people out of the mud than if all the money were concentrated in the construction of costly highways."

Figuring the annual cost of bituminous surfaced macadam road, Mr. Wright gives the original cost per mile as $21,150; yearly sinking fund charge on a basis of fifteen years of life, $1,137; average yearly interest charge, $1,058; yearly maintenance cost, $500. This gives a total of $2,695.

Refuse Collection in England

An English engineering paper gives interesting information concerning the use of motor vehicles by English cities for the collection of house refuse. In Birmingham, which was one of the earliest to adopt electric vehicles for this purpose, such vehicles are considered more economical than horse-drawn vehicles beyond a radius of 1¼ miles from the point of disposal, according to the statement of Mr. Cook, one of the officials of the Cleansing Service of that city. Mr. Cook believes that even within that radius "the use of larger capacity vehicles, combined with electric auto-trailers may outclass the horse."

In another city, Durham, gasoline motors have been employed, a saving of about $3,000 having been effected last year by changing to these from horses, while the complaints have dropped from 300 or 400 a month to not more than 3, indicating much greater efficiency with the rapidly moving motor vehicles. This English paper points with pride to the fact that Ford trucks and an English truck known as the "Albion" having both been tried in this work, the cost of collection by the former figures out one shilling and five-and-a-half pence more per ton than by the Albion. Apparently, however, the Ford car has obtained much the same standing there that it has in this country, one English manufacturer having placed on the market a low-hung trailer to be hauled by a Fordson tractor, the trailer being hauled by horses during collection and a number being combined into a train to be hauled by the tractor to the dump.

Recent Legal Decisions

FAILURE TO COMPLETE STREET IMPROVEMENT IN TIME

A street improvement ordinance adopted under the San Francisco Charter, provided that the contractor's failure to complete the contract within the time fixed or within the extension therein provided would render the contract void, and that no assessment should be made for the work done under the contract. The California Supreme Court holds, Flinn v. Shafter Realty Co., 112 Pac. 194, that a failure of the board of supervisors to grant an extension of time within the original period is not a mere error or informality which can be cured by failure of the property owners to appeal or by a subsequent extension of the time, and if the work has not been done or extension granted the assessment is invalid.

LIABILITY FOR DAMAGE FROM INCINERATOR

The North Carolina Supreme Court holds, Dayton v. City of Asheville, 115 S. E. 827, that where a city has a right to erect an incinerator and to maintain it for the benefit of the public, in the exercise of its governmental duty, it will not be held civilly liable to individuals for injuries resulting therefrom, when properly built and operated, upon the theory of a trespass, in the absence of some legislative authority or a statute conferring such right of action. But this does not militate against the right of recovery for a taking or appropriation, in whole or in part, of property for a public use without due compensation.

This distinction may become important upon the question of whether the statute of limitations applies in an action against the city. For an irregular, intermittent and variable trespass, if the city should be liable for such a tort at all, the plaintiffs, claiming damage to their property from smoke, ashes, etc., settling thereon, and the pollution of the atmosphere, would be entitled, under the state tatute of limitations, to recover all damages accruing within the three years next immediately preceding the commencement of the action, provided proper claim had been made therefor, as required by the city charter. But under the theory of taking by eminent domain, where the injury is permanent, constant, and continuing, the cause of action accrues and limitations begin to run from the time of the first substantial injury.

CONTRACT TIME FOR COMPLETING PAVING DOES NOT INCLUDE SUNDAY WHERE SUCH WORK IS PROHIBITED

A paving contract to be performed in St. Joseph, Missouri, provided that the job be completed within 130 days from the date of its award, "the time of beginning, rate of progress and time of completion being essential conditions of this contract." It is held, Van Haaften v. Clayton (Mo. App.) 246 S. W. 964, that the time within which the work was to be completed did not include Sundays, since, under the Missouri statute (Rev. St. 1919, Sec. 3596) the contractor could not legally be required to pursue the labor of constructing the pavement on Sunday.

CITY CANNOT BIND ITSELF TO BE SUED OUTSIDE OF ITS COUNTY

The weight of authority holds that any action against a municipal corporation is of an inherently local nature and must be brought in the county in which the municipality is situated. The view expressed by the courts is that it is of the greatest importance to the welfare of such public bodies, as well as of the citizens of municipalities, that their officers be not subjected to being called away from their duties to attend the trial of cases at distant points. Therefore, the Texas Court of Civil Appeals holds, City of Corpus Christi v. Oriental Oil Co., 246 S. W. 718, that a municipal corporation cannot be bound by a contract limiting or changing the venue of a cause of action against a municipality for goods purchased so as to render a suit maintainable in a venue beyond that of its domicile.

ROAD CONTRACTING ENGINEERS' FEES

The Arkansas Supreme Court holds, Carter v. Bartholomew, Road Improvement Dist., 246 S. W. 487, that a road contracting engineer's fee of $50 a day is excessive. An engineering firm contracted along with a state highway engineer, to perform services for a road improvement district. The latter, by virtue of his holding office, was held disqualified from recovery for his services. But the engineering firm was not disqualified, because of their contracting along with the highway engineer, from recovering for their services, there being no collusion between the firm and the highway engineer, who was not a partner of the firm.

CITY'S POWERS OF CONDEMNATION AND RATE FIXING NOT REDELEGABLE

The Missouri Supreme Court holds, State v. Maitland, 246 S. W. 267, that the grant of power to condemn property is a grant or delegation of power by the state to the city, and not to any board or commission of the city, and it has serious doubt of the right of a city by either charter or ordinance to redelegate this power to a water commission, that is, the power to determine upon and select the property to be condemned. A city's delegated power to fix rates to water consumers is a legislative function, which may not be redelegated by the city to a water commission.

CONCLUSIVENESS OF ENGINEER'S DECISION

The Oregon Supreme Court holds, Spokane County v. Pacific Bridge Co., 213 Pac. 151, that the rule that where a contract for public work, in express terms, makes the decision of the engineer final as to the performance of the contract, such decision is conclusive on the parties, does not apply where the contract makes the decision of the engineer who supervised the work final as to the true construction and meaning of the profiles, maps, plans and specifications, but does not make his decisions in respect to performance of the work final and conclusive upon the parties.